LOGIC;

OR

THE SCIENCE OF INFERENCE.

A

SYSTEMATIC VIEW OF THE PRINCIPLES OF EVIDENCE, AND
THE METHODS OF INFERENCE IN THE VARIOUS
DEPARTMENTS OF HUMAN
KNOWLEDGE.

BY

JOSEPH DEVEY.

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PREFACE.

The following pages comprise an attempt to systematise the various forms of inference engaged, either in the construction of science, or in the generation of opinion and belief. Notwithstanding the diversity of the subject, the author has endeavoured to meet its widest requirements; not neglecting, while he has devoted the greater portion of the treatise to the consideration of the laws and methods of inference in their simplest and most complex combinations, to include in his design a description of the different subject-matter on which they are ordinarily employed, and the foundations on which their processes ultimately rest. If, to views so discursive, he has been able to impart anything like systematic completeness, the merit is due not so much to him as to the excellent treatises which have already elaborated distinct portions of the subject and guided him through much of his labour.

Logic, owing to the opposite schools of metaphysicians, has met with various, and even conflicting treatment in nearly every age. It appears to be the only subject of which the difficulties multiply with the spread of knowledge, and which, instead of disentangling itself from the quarrels of the past, periodically carries forward all its old perplexities to be added to the account of the present. The disputes of Ænesidemus with the ancient stoics is still rife in Germany, and

the gauntlet which Bacon threw down to the peripatetics of his age, is as warmly taken up by their successors in the present, as if the Novum Organum had been only yesterday ushered into the world. Hence, in the present vacillating state of the science, with its limits as well as its subject-matter depending on each individual's fancy or caprice, no one knows when he finds the name of Logic on the back of a work what he is to expect. It may be a dish of metaphysics, a dry piece of scholastic wrangling, or an abstract treatise on method; and should the views of the author be ultra, the reader will not improbably find a great many pages taken up with anathematising every view of logic but that assumed in the text.

Now, this is not a satisfactory state of that science which concerns the operation of the faculty in which men chiefly glory, not only as the mark which pre-eminently divides them from the brute creation, but also as the primary source of those distinctions of rank and supremacy which obtain in society. Nor has the writer met with anything in logical treatises to necessitate the conflicting diversity of view in which they regard the science. There is nothing in the body of Aristotle's speculative views to hinder them from being engrafted on the practical doctrines of Bacon; nor anything in the *à priori* methods of Descartes essentially antagonist even to the inductive methods propounded by Comte and Helvetius. Apart from the metaphysical tenets of these schools, the general body of their logical doctrines may be combined in one system. All have their distinct functions in the generation of scientific belief, and by the diversity of view which they bring to bear on any object, tend to strengthen and verify the accuracy of each other's processes. The writer has, therefore, avoided the fragmentary treatment of logic pursued by his predecessors, and attempted to place the science on its right basis, by grouping around

the central idea of Inference the various methods and systems which are connected with its functions in the leading divisions of knowledge. The instruments may be diverse, but they all range themselves as so many subordinate conceptions round the leading idea of the science, and may be regarded as so many means of dissipating doubt, detecting error, and placing truth beyond cavil.

Some persons manifest as much care in adjusting the limits of a science, as if they were laying down the confines of provinces, or the boundaries of empires. The writer has not deemed this exact nicety beneficial to a science which is in a greater measure than any other interwoven with every department of human knowledge. He has therefore introduced into his pages everything which had a strong bearing on inference, whether as regards metaphysical discussions on the foundations of evidence, or collateral disputes which have been raised in the present day on the doctrine of quantification. He has not, however, adopted any of the innovations which Sir W. Hamilton would introduce into the scholastic logic, nor indeed omitted any portion of the Aristotelian system, except the part excluded by the introduction of special canons for each figure. With regard to the utility of the peripatetic system and its correlation with the other branches of logic, the views of the writer are in a mean ratio to those of Mill and Whately. While he concurs with Bacon in deeming this branch of the subject more directly applicable to the moral sciences[1], he does not consider it entirely useless in physical investigation; inasmuch as there can be no inference which may not be faulty as to form, and which, therefore, is not open to receive the aid of the syllogistic canons.

In conclusion, the author expresses his conviction that

[1] Bacon's restriction referred to politics and theology; but politics in his days was considered an *à priori* science.

there are only two legitimate methods of treating a practical system of logic, viz.: Either by pursuing the method adopted in these pages, of systematising all the processes of inference which are embodied in the various departments of knowledge; or by selecting some particular province or group of sciences, and pointing out the inferential methods employed in their construction. In the direction of the first, or general system of logic, Mill's is the only attempt that has hitherto been made, and he has excluded the Aristotelian portion of the subject. Of the last, or specific kind, several treatises have appeared, but in most cases carrying down the subject to subdivisions too minute to entitle Logic to the claim of a distinct science[1]. When confined to the investigation of a single subject, as in Oersterlen's *Medicinische Logik*, or in the clever treatise of George Cornewall Lewis, *On the Methods of Observation and Reasoning in Politics*[2], Logic, however valuable the results in other respects, is taken out of its niche in the temple of the arts, and blended with the substance of the other sciences.

J. D.

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[1] The most amusing in this way is decidedly that on Parliamentary Logic by "Single-speech" Hamilton. [2] The reader may profitably consult another work by this ingenious writer, On the Force of Authority in Matters of Opinion.

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HISTORICAL INTRODUCTION.

It does not appear that either the African or Asiatic nations were able, at least before the Grecian era, to distinguish between the value of rational causes and fabulous traditions, or ever habituated themselves to analysing their thoughts, with a view to elaborate a code of rules for the practical guidance of the reasoning faculty[1]. The early Greeks were the first people who deemed it requisite, to the acquisition of correct knowledge, to inquire into the real causes of things, but their method of investigation, faltering and uncertain, led to few discoveries, nor gave them sufficient confidence to draw up a code of logical rules for any other purpose than that of verbal dispute. Zeno the Eleatic is the earliest logician to whom antiquity refers[2], as furnishing the Greeks with a method of wrangling calculated to ensure its possessor a triumph over any opponent who might venture to question his thesis, but without further use or pretence, unless it might be the collateral one of sharpening the mental faculties, and leading to habits of intellectual acuteness. Though Socrates charges the author of this work with obscurity and confusion, in that part which treats of consequences[3], he did not scruple to adopt the interrogatory method of disputation (ερώτησις) which forms the leading

[1] An account is given in Colebrooke's essays, vol. ii. p. 292, of an Hindu logic, by Gotama, which has, however, so many striking resemblances to the Aristotelian system, that critics are disposed to rank its publication as posterior to the Organon, and to place its author among the disciples of the Stagyrite. See *St. Hilaire, Logique d'Aristote*, ii. 330. [2] Lived in the LXXX. Olympiad, or about 460 B.C. [3] Plat. Parmen.

feature of the work, and to apply the collection of sophistical questions it contains for the purpose that Zeno pointed out, of leading any person with whom he might happen to dispute, by the concession of some point which seemed unavoidable, into the meshes of absurdity.

Socrates, however, in furnishing brilliant illustrations of the efficiency of Zeno's dialectics, distinguished three modes of analysis, and laid the foundation of logic proper, by introducing the terms *genus* and *definition* into the Greek language. The first analytical method, which is similar to that employed by geometricians, consists in admitting, by hypothesis, the truth of a proposition until we reject or affirm our judgment, by inferentially linking it with some other recognised truth or absurdity, of which an example may be found in the instruction given by Socrates to Critobulus[1], relative to the means of obtaining true friends, and where he teaches Euthydemus the necessary conditions of true government. The second of these methods either ascends from particular facts to abstract truths, or detaches general notions from the particular groups which they include, and may be characterised as analogous to the method pursued by naturalists, and the inductive system of Bacon[2]. The third separates the notions which are associated with complex ideas, and by distinguishing their properties, tends to dispel the confusion which is apt to lurk beneath their indiscriminate assimilation. This method has some resemblance to the resolving process of mechanicians and chemists, and is warmly recommended by Condillac. Perhaps there is nothing on which Socrates bestowed more attention than this case of determining complex ideas by a close examination of the elements into which they are capable of being resolved; as may be seen in the Memorabilia[3], where he endeavours to define the idea of wisdom, virtue, goodness, justice, and piety; and in the second Alcibiades, where he distinguishes the different species of ignorance, with their corresponding effects; and in the Crito, where he fixes the true value to be at-

[1] Xenoph. Memor. ii. § 13; iii. § 6. See also Plat. Meno and the first Alcibiades. [2] See Socrates' Conversation with Aristippus, Xenoph. Memor. ii. § 1; with Charmides, iii. § 9; and Euthydemus, iv. § 9. Also Plat. Hippias. [3] i. § 22, 23; iii. § 16; iv. § 15—18.

tached to the opinion of the people, and the essential characteristics of justice. Occasionally Socrates weaves the three modes of procedure into the same demonstration, alternately employing each according as the different parts admitted of their application.

Previous to the time of Socrates, philosophy had been delivered in language borrowed from the poets, and even as taught by Zeno, it only furnished a species of amusement to the sophists who met beneath the royal portico of Athens[1], to perplex each other with metaphysical subtleties, and darken thought by words of vague import. Socrates was the first to aim at the creation of a philosophical language, by introducing, and insisting upon, the practice of definition as an essential preliminary to correct inference[2], and resolving all the disputes of his day into cases of verbal equivocation. He dared to strip philosophy of the meretricious ornaments of rhetoric, and make language a faithful mirror for the reflection of the most delicate rays of thought.

Of the pupils of Socrates, Euclid and Antisthenes developed the doctrines of Zeno. The former expanded the third part of his treatise which referred to sophistical questions, and is the author of many of the fallacies attributed to the Stoical School. Simon of Athens and Simmias of Thebes were closer followers of Socrates; but the logical treatises in which they professed to methodise[3] the system of their master have not come down to us.

Plato wrote no treatise on the science, and what he delivered must be collected from the body of his writings and his method of treating the subjects of the dialogues. From these sources, it appears that he had an adequate conception of the inverse methods of analysis and synthesis, and wrote a work explanatory of their different properties, which, however, has not come down to us. In his Philebus he prefers the latter method, but in his written or exoteric works he constantly employed the other. Plato only discriminated two modes in which reason can be exercised: viz., that of departing from general principles to arrive, through the medium of perception, at the knowledge of individual facts, and the mounting from these general principles, with-

[1] *στοια βασιλεος.* [2] Arist. Metaphy. i. 6. [3] Simon, Art of dispute; Simmias, On truth and reasoning.

out the aid of perception, to reach a primary principle by which the different branches of knowledge are linked together, and obtain a fixed and immutable character. His *à priori* doctrine concerning ideas, which he made the keystone of his system, would not allow him to admit any species of inference to be legitimate, from the particular to the general, and compelled him to place the perfection of reason in resolving notions into all the qualities they bore, and in seeking to educe from abstract propositions all the furniture of the universe. He, however, contributed to keep alive among his countrymen that caution respecting the use of complex notions which Socrates had introduced, by tracing most of our errors to the vagueness and obscurity of this class of ideas; and by viewing language simply as an instrument of thought, which caprice, as well as nature and analogy, had conspired to form, he impressed upon his followers, with no less force, the necessity of defining all terms of a compound or abstract character before employing them in reasoning.

The treatises of Aristotle, which his Greek as well as modern commentators have agreed to consider, under the title of the Organon, as parts of one work, embrace an exposition of every principle which concerns method, truth, the operations of the reasoning faculty, and the foundations of evidence; subjects which, being widely distinct from pure metaphysics, evidently show that Aristotle had not that limited idea of the domains of the science within which some illustrious modern logicians would fain confine it[1]. Aristotle regarded logic as the code of human reason; but, since ideas are the materials of the edifice it is called to construct, the Stagyrite deemed it expedient to commence the work with an inventory of the immense number of conceptions with which the mind is furnished, marshalling them in distinct rank and file, that every notion may be found in its proper class, and every class ranged under the head of its appropriate division. This portion, which comprises the categories, may be regarded as the frontier-ground where psychology is blended with logic—where the one science terminates and the other begins.

[1] See Whately's Logic, Introd. p. 8, and Sir W. Hamilton's critique on this work in the Edin. Rev. for April, 1833, or in his recently collected essays.

To combine the isolated elements expounded in the categories is the function of judgment, which, verbally expressed, gives rise to propositions[1]. Several propositions connected by certain laws constitute reasoning, and the most simple form of it is that which unites two ideas by declaring their identity with a third, through the medium of three propositions, termed the premises and the consequence. Hence the construction of the syllogism—a Greek word, signifying this association of verbal judgments, which Aristotle follows out into all its developments, and of whose legitimate formation he clearly enounced the rules. The Book of Interpretation, comprising the second portion of the Organon, relates to the exactitude of propositions; the Prior Analytics, which immediately succeeds, expounds the law of the syllogism, its figures, and modality.

The art of combining syllogisms in a compact chain of conclusive demonstrations and the general principles of evidence are taught in the Posterior Analytics. The subjects of syllogistic probability and the laws of dispute, so far as matters of opinion are concerned, are laid down in the topics; while the concluding section of the Organon is employed about sophistical arguments, or the means of detecting error in syllogisms constructed in contravention of the laws of reasoning.

Of the general doctrines of Aristotle concerning the foundations of evidence and the different scientific methods, it may be sufficient to state that he regarded experience as the source from which the materials of each science must be drawn, and pointed to induction as the proper mode of constructing general propositions out of the facts which it yields; nevertheless, he rather inconsistently refused to the intermediate axioms so derived any character of certainty, until they had been applied by deduction to demonstrate the existence of the particular facts out of which they had sprung. His nominalism did not even lead him to deny the existence of universal axioms which derived their cogency from other sources than experience, or hinder him from tracing our knowledge as much to the intrinsic perception of such principles, and the consequences evolved out of them by deduction, as to the recognition of simple facts and

[1] De Interpret. c. 2, 3, 11, 12.

the general laws to which they inductively led[1]. Hence he clearly distinguished the two modes of knowledge—mediate and immediate: the former identified with proof, the latter with first principles; which he strongly insisted that no person could attempt to prove without landing himself in the belief of the impossibility of knowledge[2]. He also assigned a limit to definition as well as evidence, and clearly shows that any effort to define simple terms must involve the logician in a vicious circle, since it can only be achieved by words of a more complex character, whose signification already has assumed the object of the definition which is sought to be established[3]. Aristotle also distinguished the definition of names (*i. e.* that which assigns any arbitrary meaning to a term otherwise indeterminate) from the definition of things, which he instructs the logician to express in terms of the nearest genus and most approximate difference, if he would compare the thing defined with those which have most analogy with it, and discriminate their common properties and several points of difference. To define, however, is not to demonstrate; the object of definition being rather to serve as a basis of science, by fixing the sense of terms to be employed in eliminating new truths than as a direct inlet to fresh knowledge[4].

We meet also in the same part of the Organon[5] a distinction between absolute and relative principles, the first of which Aristotle places in the nature of things being expressed in universal axioms and propositions, the furthest removed from sense; he assigns the latter to the judgments we make respecting individual facts, which, as they are mainly derived through sensation, and are most proximate to sense, are the first in the order of knowledge[6]. To this contrast he refers three others: that of the universal and particular, that of the necessary and contingent, and that of the essence and accident. Absolute knowledge embraces the real essence of things, which Aristotle invested with the attribute of necessity; relative knowledge comprises what is particular and contingent, and every other property connected, in Aristotle's view, with the accident of things. The

[1] Post. Analyt. b. i. c. 1, 2, 8, 18. [2] Ibid. b. i. c. 3. [3] Ibid. b. i. c. 1. [4] Ibid. b. ii. c. 1, 2, 3, 4, 12, 14. [5] Ibid. b. i. c. 2. [6] Ibid.

first only, admitting of demonstrative proof, deserved the name of science; the second, as affording scope merely for the inductive method, appertained solely to belief and opinion[1].

It is unfortunate that these distinctions should have been mainly founded upon a glaring error in the Aristotelian physics: viz., that of attributing contingency and accident to what were simply isolated instances of general laws modified by peculiar circumstances, as they led the Stagyrite to divest one branch of proof of the certainty which belonged to it, and thereby mainly contributed to disseminate those false ideas concerning induction which kept positive science stationary for nearly two thousand years. If induction could only explore contingent events, and if experience can only be consulted through its method, it is evident that all the facts derived from this source must partake of uncertainty, and that Aristotle resolved all our knowledge into a principle which had no sufficient basis. By what means demonstration converted the facts to which it led into a certainty they could not possess even from the most compacted link of inductive inference, or how universal, absolute, and necessary propositions can be identical with particular and contingent judgments derived from sense, the Stagyrite does not inform us; and the Organon is consequently transmitted to posterity with doctrines upon the applied part of logic which conflict with each other, and convey, with respect to the most fecund methods of introducing the empiric element into science, the falsest impressions. It is, however, fair to add that the greater portion of Aristotle's logical treatises has been lost, and that those which have come down to us have not escaped the ravages of time and the mutilations of commentators.

With the exception of Theophrastus and Eudemus, who extended the boundaries of the Aristotelian logic by the invention of the five moods and the important doctrine of hypotheticals, we meet with no important writers on the science till the early centuries of the Christian era. In the intervening period the writings of Aristotle seem to have been buried, though the logical portion of them was traditionally handed down by his disciples, and contributed to

[1] Prior Analyt. b. i. c. 2, 3, 12, 17; ii. c. 24. Post. Analyt. b. i. c. 1, 4, 6, 8, 13, 29, 30, 33; ii. c. 3, 4, 7, 12.

guide the speculations of some of the Roman sages. In the second century, however, owing to their discovery by Andronicus of Rhodes, they met with a considerable revival, and we find them the subject of many learned commentaries by Galen, Ammonius, Alexander, and Porphyry. Yet not one of these made any valuable accession to logic, the labours of Galen[1] being confined to the discovery of the fourth figure, and those of Porphyry to his work on the predicables. Their writings, however, though unimportant in themselves, were not unproductive in results. They gave rise to a spirit of philosophic inquiry among the Arabians when the thirst of conquest had subsided, and, by broaching the question of nominalism and realism among the Mahometan and Christian doctors, led thought out of the stagnant flats in which five centuries of war and rapine had confined it.

From the scholastics logic inherited a great abundance of acute distinctions which helped to disperse much of the confusion apt to lurk in terms and propositions of a complex character; but it is hard to say whether the waste of verbal subtleties with which they encumbered the science, and their

[1] This is the current opinion at Oxford; but it is fair to state that Galen wrote a treatise on the art of demonstration, which, on the authority of Hipp. Decreta (ii. cap. 30, ix. cap. 1), had it reached us, would have placed him in the rank of the most pioneering logicians of the present day. Galen is there represented as placing the radical vice of the ancients in seeking fecund propositions for science in abstract dialectics, and in abusing general notions by substituting them for the light of facts; and is made to define with surprising exactness the nature of synthesis and analysis, with their correlative methods, pointing out the errors of relying on either of these methods to the exclusion of the other, and the necessity of combining both as the condition of perfect science (De Hipp. et Plat. Decret. ix. cap. 5). If we may believe these authorities, he makes sense the criterion of simple objects, the understanding those of complex and rational ones, but subsequently establishes the mutual dependence of these two channels of knowledge. Observation imparts the signs of things, the understanding abstract truths; the first is the origin of discovery, and leads to the decomposition of the principles of the sciences, the second extends discovery to new cases by demonstration, and establishes the alliance of the facts so pointed out, with empirical truths, a union which alone constitutes perfect knowledge (De Optim. Sect. c. 2; De cujusque animi prec. cogn. atque Med. c. 3, 6, 8; De optim docendi genere, de Hipp. et Plat. Decret. vii. 8, ix. 1, 8). Galen traces the greater part of our errors to precipitate assimilation.

constant use of the syllogism in its naked, skeleton-like form, did not counterbalance the advantages which undoubtedly sprung from the exactness of their terminology. Their want of elegance, however, in logical exposition must be traced to the slender resources which Boethius'[1] translation afforded them, to whom they were mainly indebted for their knowlege of the Organon; while the entire absence of anything like physical science or experimental observation threw their minds upon abstract principles and *à priori* reasoning, and may form some excuse for their devotion to pursuits in which the most gigantic intellects must have run to seed. Their logical works are multitudinous; yet all wear the same aspect and teach the same doctrines, unless in the solitary point about universals, on which only they presumed to differ. Diligent bibliographers[2] have been able to catalogue nearly two thousand treatises from this source, all of which may be characterised as the bare formulising of the peripatetic logic[3]. It is strange that men should have taken such pains to re-echo what had been so often repeated before them; but there were only two or three subjects upon which the mind could be employed—viz., metaphysics, logic, and theology, and the religious uniformity of the age caused the same doctrines on these topics to be continually reproduced.

As soon, however, as Greek learning had been scattered over Europe from the shrines of Constantinople, a spirit of disaffection at once manifested itself against the Stagyrite's supremacy; and, as his assailants deemed the Organon the citadel of his empire, they sought, in destroying that, to complete his overthrow. Their efforts do not appear to have ended in anything very decisive, since they attacked the old logic entirely on false grounds, and had nothing to set up in its place, save some crude theories about method and the value of dichotomies. Nizolius flanks his attack[4] on the Organon with the strange assertion that correct reasoning

[1] Published at the commencement of the sixth century. [2] See Blakey's Logical Catalogue. Even he has not mentioned half of them. [3] The treatise of St. John of Damascus is the only exception which we encountered in looking over a formidable number at the Cheetham and Bodleian libraries. [4] De Veris Principiis et Vera ratione Philosophandi, ii. c. 1.

consists in a clear and transparent diction, and confounds persuasion with conviction in attributing to the flashes of the rhetorician the effects which can only follow from sound reasoning. Ramus, who endorsed many of the views of Nizolius, affirmed with rather amusing gravity that he had studied the Organon for ten years without becoming a better geographer or a wiser historian; and proceeded to attack that treatise, on the ground that it did not teach men facts[1]. Yet the method of division by dichotomy, which he attempted to substitute for the peripatetic logic[2], was simply an unnatural extension of the disjunctive syllogism, whose functions the Organon had already pointed out; and which, if practically enforced, would have stunted the growth of reason by reducing the entire sphere of its operations to one of its least significant forms. This substitution, however, does not appear to have been sufficiently absurd to lack supporters in more recent times: its innovating character found strong favour with Milton[3], while Condillac advocated it in his Calcul, and Bentham in his Chrestomathia.

The zeal with which Ramus went about the demolition of the Organon was frequently displayed at the sacrifice of consistency; and the charges which he urged against its author, if they had any weight, would often rebound with much more force against himself. He reproaches Aristotle with his exclusive adoption of the analytic method, and gives his preference to synthesis; while his celebrated divisions (dichotomiæ) are so many glaring instances of analysis. His system received the name of the Causal method, not because it offers any instrument for the investigation of causes, but because it places in causes a means of definition, and one of the characters which determine the conformity of argument with things.

Patrizzi and Concio likewise became famous about the same era by their audacious attacks upon the Stagyrite; but beyond a few isolated gleams of light upon method, they do not appear to have been in possession of anything so good

[1] Animadversiones in Dialecticam Aristotelis, i. iv. For its development, see Institutiones Dialecticæ, ii. Paris, 1543. Scholæ Dialecti. Bas. 1559. [2] Ramus took his bifurcate division from the Isagoge of Porphyry. [3] Artis Logicæ Plenior Institutio, 1672.

as the system they attempted to pull down. Patrizzi, indeed, gave Bacon that magnificent hint about laying the foundations of philosophy entirely anew, and erecting the fabric by the scaffolding of induction; but his attempt at the task was converted by the platonic ideas he adopted into a ludicrous travesty of his own principles. Concio's views of method were far more distinct, and they are laid down with a particularity which shows that his conceptions grew out of a practical acquaintance with the modes by which the sciences might be moved out of the ruck in which they had so long been embedded. In his work on the subject[1] he places the problem of logic in determining the relation of the known to the unknown, which may be distributed under different classifications: that of the relation of the general to the particular; of the whole to its parts; of the compound to the simple; of the cause to the effect; or that of the reverse order of these divisions. Each development of these relations led him to distinguish three sorts of analysis, not discriminated up to his time, and subsequently confounded by Condillac—viz., that which proceeds from the general to the particular, from the whole to its parts, and from the ends to the means. They are, however, commonly united, though one of them generally predominates in the same investigation. Of the three, Concio gives the preference to that which proceeds from the end to the means, or from the effect to the cause; and controverts the notion that analysis is the best instrument of discovery, and synthesis the most available for the purposes of exposition. According to Concio, the true method of instruction is to reveal the paths which led the discoverer to the truths we seek to explain[2]. For the rest, in his definitions, nomenclature, and classifications, he follows Aristotle; asserts with the Stagyrite the illogical consequences of defining the first and last terms in the ladder of reasoning, and, like him, propounds the general principles, but failed to develope the theory of the combination of rational deductions with experimental truths.

As the discoveries, however, of Galileo gradually revealed the hollow [nature of the Aristotelian physics, the Organon, which had been partly instrumental in their formation, began

[1] De Methodo, § 9, p. 29. [2] Ibid. § 17, pp. 84—90.

to lose ground in proportion, and a voice was heard from England's great chancellor arraigning the author on the charge of having corrupted science by an extravagant perversion of logic[1]. Bacon, however, in descending into the details of the impeachment[2], did not evince any clear ideas of the points where Aristotle had failed, though he exhibited astounding ingenuity in unmasking the several causes which had impeded the progress of science, and in constructing a system calculated to neutralise their effects in future. The error of the Stagyrite was hardly, as Bacon alleged, in introducing a mode of reasoning compounded of propositions and middle terms which were liable to all the illusions of language, since no one can demonstrate without the aid of this method; but in the assumption of metaphysical axioms and definitions untested by experience, in conformity with which he attempted to prejudge every fact that nature presented[3]. Against the errors which arose from the application of such principles, Bacon effectually provided by excluding every generalisation from the domain of philosophy which did not fairly arise out of the rigorous examination of the phenomena it included; and in framing a code of rules by which the mind might be led from particular facts to intermediate axioms, and from these ascend to the universal laws which enchain the universe. When general propositions were so reached through the medium of a legitimate induction, Bacon allowed the utility of the inverse method of demonstrating the individual facts which these universal statements included, and tracing their remotest consequences, by which we are led not only to the particular propositions by whose immediate consideration we rose to their discovery, but to others of which we had no previous knowledge[4].

Hence it will appear that the doctrines of the two Orga-

[1] Novum Organum, b. i. aph. 63. (Bohn's Scientific Library.) [2] See Introduction to the De Augmentis. [3] Such are the principles that nature abhors a vacuum, the abstract perfection of circular motion, his separation of celestial from terrestrial mechanics, and his definitions of light and heavy, motion and transparency formed without any consideration of the objective realities to which they refer, and sometimes in defiance of them. [4] Nov. Organum, i. aph. 18; De Augmentis, i. vi. c. 2.

nons are not so conflicting as is commonly reputed, and that after abating some exaggeration of view on each side, one may be fairly taken as supplementary to the other. Aristotle insists, as well as Bacon, upon the necessity of blending abstract with experimental truths if we would attain to perfect science[1]; but both mistook the exact forms in which the combination should be effected, one making induction (the instrument of investigating truth) the chief agent in the formation of each science; the other, deduction, which is more properly the means of demonstrating truth when discovered. The error, however, lies only in the extreme length to which they pushed the two mutually corroborative poles of proof, and would have disappeared, had each only taken the pains to reconcile the discrepancies of their own statements on the subject. Bacon refused to take things as principles of evidence upon any other testimony than experience; he nevertheless frequently admits the cogency of demonstrative laws, which derive their force from abstract truths, to discover facts which have not fallen under our observation. Aristotle, while he resolves all our knowledge into experience, strips induction, the only method by which it can be consulted, of every claim to certainty. It does not appear to have occurred to either that abstract principles can only be combined with experimental truths through the blending of their correlative methods, and that their respective functions must be employed according as each science admits of their influence. To deny the relevancy of demonstration because the laws of induction have been legitimately propounded, is as absurd as to impugn the utility of the windmill because the steam-engine has been invented; and if Aristotle and Bacon have contributed to this error, they have contradicted themselves as much as each other.

Though Bacon's method has received no brilliant confirmations out of the circle of the experimental sciences, he expressly urges its competency[2] to meet all the purposes of scientific inquiry. This statement, however, is only true so far as the introduction of the empiric element is concerned, and the verificatory functions which it is only competent to discharge where abstract evidence can be brought to the touch-

[1] Post. Analyt. b. i. c. 1, 2, 8, 18. Introduction to the Instauration de Aug. i. vi. c. 2. Nov. Org. i. aph. 18. (Bohn's Scientific Library.)
[2] Novum Organum, b. i. aph. 127.

stone of facts. Out of this sphere its application is unnatural, and the attempt to obtrude it into ethical science has given birth to utilitarian chimeras, as wild and fanciful in their way as those which arose from the unseasonable application of the counter-method to physics. In general, however, abstracting from the zeal of one or two small philosophical sections, who place each other out of the pale of reason, the functions that the two Organons are destined to fill have been practically assigned to them, and their spheres kept, perhaps, even more distinct than is advantageous for science. Aristotle still rules over ethics, hermeneutics, and jurisprudence, and as the master of scholastic divinity he yet contrives to mould the minds of those who sway the Christian world; but it is the distinguished prerogative of our immortal countryman to preside over the field of nature, and teach man to unveil its secrets and subject its wildest elements to his will.

Notwithstanding that the claims of the inductive method in all cases of appeal to facts had been urged before Lord Bacon, and by none with more philosophical exactness than his great namesake[1], he was the first to give them an extensive development, and to announce them with that spirit-stirring eloquence which, conspiring with the awakening thought of the age, gained them a speedy entrance into the scientific mind of Europe. After the publication of the Novum Organon all logic seemed to be resolved into method, and the success of that great work raised up rivals as well as imitators in that department of the science. Descartes would not admit that diversity of doctrines could be attributed to any other cause than the diversity of modes pursued in their establishment; and as he regarded mathematical proof as furnishing the highest gradation of certainty, he endeavoured to raise a theory of method on the geometrical model[2], and in its execution penetrated into some of the most subtle operations of thought. In conformity with his general principle, he was obliged to avow the homogeneous nature of all knowledge, which he placed in the composition of known things[3], and by not accepting anything as certain

[1] Roger Bacon, Opus Magus. [2] Discours sur la Méthode, i. ii. Règles pour la Direction de l'Esprit, part i. r. 4. Medit. Pref. Principes de Philosophie, Pref. [3] Règles pour la Direction de l'Esprit, p. ii. r. 13.

but what immediate intuition or legitimate deduction reveals, to limit induction to the functions of determining the state of a question, of disengaging it from irrelevant matter, and subdividing it into complete and consecutive categories; all which operations Descartes viewed with Aristotle as so many preliminaries to demonstration[1]. Hence he does not establish his series of truths by classes of facts, gradually becoming more general and less complex in the ascent of proof, but by chains of inference which derive their force from the most abstract laws of thought; and here we meet with the great divergency of the two paths pursued by him and Lord Bacon.

Evidence, according to Descartes, is the result of the legitimate exercise of all the operations of reason in the acquisition of knowledge. Induction and analysis prepare the way; intuition commences, but deduction completes the work. In the pursuit of the latter branch, we are led from words, or abstract principles, to things; from the same to the same; from the whole to its parts, and *vice versâ*, or from the effect to the cause, and inversely[2]. All his rules for the direction of the mind in these operations may be reduced to the following. To submit our thoughts to the test of a rigid analysis, removing all simple presumptions, doubtful opinions, and obscure notions[3]. To examine if the thing to be determined spontaneously presents itself to us, or whether it is known through the medium of another object, and in the latter case to discover the class from which it is to be deduced. For the rest, every scientific question may be reduced to the solution of a mathematical problem; since it encloses an unknown object which it is necessary to disengage and explain, by obtaining the sign and determining the conditions which belong to it[4]. Descartes failed to discriminate with sufficient precision the methods of analysis and synthesis, misled by the error that they admitted of the same development in speculative philosophy as in geometry.

[1] Post. Analyt. ii. c. 13. (Bohn's Scientific Library.) [2] Règles, &c. p. ii. r. 12. [3] Règles, &c. p. i. r. 12. Dis. Math. p. i. Princip. de Philos. part i. art. 66. [4] Règles, &c. p. i. reg. 12; p. ii. regs. 13, 17—19.

He deemed his meditations an instance of analysis, because they established the knowledge of God as a cause, from the effect of his own existence, notwithstanding his proof of the Divine Being is eminently synthetic. In another portion of his works[1] he attempted to establish his metaphysical system upon a synthetic basis. But, on comparing the two modes of procedure, we find only a difference of arrangement in the compilation of the work, and not a reverse order in the development of the ideas.

With these principles it will be readily seen that Descartes could admit no other criterion of truth than the logical axiom, "all that which is included in the idea of a thing may be affirmed of it." He considered this principle competent to legitimise all inference, and as he called his celebrated enthymeme, "I think, therefore, I am," his generative principle, or the corner-stone of the edifice, he deemed his philosophical criterion the regulating line which determined the rectitude of the facts of which the structure was composed. The discrepancy, however, of limiting intuitive certainty to one metaphysical maxim, and of assuming at the same time a logical axiom, having no connexion with it as the test of the extension of that certainty to other truths, he does not endeavour to explain, or to show how a principle purely logical can be rationally applied to any objects out of the sphere of abstract and conditional truth. Wishing to impose upon every science the same criterion of evidence, and to unfold their truths by the same method, he applies a maxim which can only regulate the interior combinations of our ideas, to legitimise the relation of real things in the objective world. Hence, as far as natural science was concerned, Descartes wrecked his genius on those abstract principles which Bacon had pointed out as the philosophical Charybdis of antiquity. By degrading induction from its legitimate functions, and endeavouring to reason out natural facts by the *à priori* method, his theories burst like soap-bubbles, almost as soon as they were formed; while the system of Bacon, in the hands of the illustrious Newton, gave rise to a philosophy founded on the basis of observation and experience, which will last so long as reason and the nature of things remain as they are.

[1] Reponse aux Premier Objections, part i. p. 441.

With the exception of a stray treatise or two, like Lord Herbert's De Veritate, Tschirnhausen's Medicina Mentis, and Spinosa's De Emendatione Intellectûs, nothing of any importance appeared upon methodology after Descartes; but logic did not retire to its old limits without making some provision for the new processes of inference that had arisen, and attempting to reconcile the operations of reason in the pursuit of the new sciences with the principles it had applied to the construction of the old. Mariotte[1] was the first to extend the Aristotelian logic by the introduction of experimental principles, and to endeavour to bring all the operations of inference into harmony with each other, by linking the increasing powers of the new calculus, the laws of induction and demonstration, to the same homogeneous axioms and definitions; thus seeking to make logic stand to the other sciences as algebra to mathematics; a supreme and universal science, offering the key to the unknown in every department of knowledge, and expounding all the methods by which truth can be sought out and demonstrated.

A work of this kind, though without aiming at so close an assimilation of the different methods of proof, appeared in the Port Royal Logic[2], written by Arnauld and Nichole with a view to bring the old Organon in closer alliance with the Cartesian philosophy. The peripatetic logic, however, though not absolutely disparaged, is considered of subordinate importance to the rules of their master, and the methods of geometry in the natural and speculative sciences; and an examination of the sophisms apt to spring from self-love, interest, or passion in points of dispute, is held out as far more likely to lead to the dissemination of truth and the overthrow of error than attention to the laws of quantification, or to the legitimacy of syllogistic moods[3]. The eight rules condensed from Descartes, intended by the authors to comprise the different methods to which the sciences owe

[1] Essai sur la Logique, printed at the end of the two volumes of his physical treatises. [2] First appeared in 1662. For a more detailed account of this work we must refer the reader to the introduction to the translation of this work by Spencer Baynes, and to Père Buffier's critique at the end of his Logic. [3] Part iv. on Method, which contains a posthumous paper of Pascal on the Method of the Geometers. Part iii. ch. 20.

their development, are not so calculated to guide the mind to the discovery of truth as to fortify it from error; a failure of design which arose from their absolute neglect of the inductive element, and the *nonchalance* with which they treated judgments of facts. Even this exclusive adherence to demonstration did not enable them to bring the new methods into harmony with the syllogysm, or to promote anything like consilience of parts in the exposition of their doctrines. They treated the old logic as a thing going out of fashion, yet too respectable to be despised, while their exclusion of the most powerful instrument of discovery left their demonstrative code much in the position of Quixote's system of strategics, which defined with the greatest precision the movements to be observed after the defeat of an enemy, without throwing any light upon the mode by which that defeat was to be accomplished.

Locke, whose treatise immediately followed, revived the old cry of the absolute worthlessness of the Aristotelian syllogism even in matters of speculative reasoning, where Bacon had confessed its power, and seemed inclined with Ramus to limit the functions of reason to correct definition and methodical analysis. Beyond these preliminaries to demonstration he refused to acknowledge the efficiency of any rules for the guidance of the judgment, and assimilated, like Descartes, moral proof to mathematical inference, that the consequence might follow from the correct statement of the conditions of the question. In determining the origin of our simple ideas, the growth of their complex forms, the reality of knowledge which he made to consist in the conformity of words with things, the use and abuse of language, and the nature of truth which he placed in the conjunction and separation of signs according as the things they denote agree or differ, Locke found a field better adapted for his keen analytic powers than the regions of pure logic, in which, through his inability to demonstrate, he was peculiarly unfitted to move. But the attempt of the Essay on the Understanding to carry the inductive method into psychology is not without its uses to the logician. It accustoms him to analyse his notions with rigorous precision, to provide against the errors of popular phraseology, and disperse the equivocations apt to cluster round certain forms of

expression. It is wrong, however, to confront it with logic, or include it in the same category. It only takes us to the threshold of the science, and leaves us there.

Condillac[1] gave a more explicit development to the views of Locke by resolving the elements of all kinds of reasoning into the mathematical principle that the same is the same, thus referring all truth to identity of ideas, and reducing the artifice of reasoning to the mere transformation of signs between propositions brought into relations of equality[2]. Hence, as algebraical forms constituted the only laws to be observed in the process of inference, the functions of logic were restricted to definition, the syllogism was treated as a joke[3], and the highest results of reasoning in any walk of science deemed of no further utility than the formation of a philosophical language. As Aristotle delighted in contrasts, Condillac was singularly enamoured of unity, and simplified everything. According to him, there was only one criterion of certainty, one method of proof; only one order of analysis and one source of error. His unique analysis consists merely of a method of division already laid down by Descartes, the specific object of which was to make a complete inventory of all the parts which constitute a whole. His sole fount of error is the employment of words without determining the ideas they are intended to convey[4].

The principal merit of Condillac consists in his clear exposition of the principles which lead to the legitimate alliance between abstract truths and judgments of fact[5]; but this portion of his work stands out in strong antagonism with the rest of his logical theory, which reduces all propositions to abstract and rational judgments, and makes their identity constitute the foundations of science. The consequences of such a principle in psychology demonstrate its illogical nature, and would land Condillac in opinions quite opposite

[1] His Logic does not follow the Essay on the Understanding in the order of time—Wolf comes between—the one being published in 1685, the other in 1753; but the authors are too commonly classed together to be separated. [2] Langue de Calcul. Objet de l'Ouvrage. L'Art de Penser, part i. c. ix. Logique, c. viii. [3] Ibid. Le syllogisme est un amusement de college ; nous ne faisons aucun usage de tout cela.
[4] Langue de Calcul. Objet de l'Ouvrage. L'Art de Penser, par. ii. c. 6.
[5] L'Art de Penser, part i. c. 8; ii. c. 7.

to those which he strove to establish, and which he is commonly supposed to represent. If all science is limited to the identity of our ideas compared with each other, irrespective of inductive evidence, we surely can know nothing of the relation of our ideas to things. We enclose ourselves in a circle of idealism, and place a gulf between our knowledge and the external world, which no logic can bridge over.

Against the extreme doctrines of Descartes and Locke there had been a strong reaction in Germany, headed by Leibnitz; but its logical bearings were not formally expounded before Wolf issued his great encyclopædia of the sciences[1]. The views of this eclectic are similar to those already attributed to Mariotte, being an attempt to combine all that was sound in the old and new Organons and methods, and vindicating for logic its natural position, as a sort of propadeutic to all the sciences, that knowledge might rest on consistent principles, and a termination be put to many irrelevant disputes in philosophy. To this end Wolf sought to shed a new light on the maxims of Descartes, of Locke, and Leibnitz, and to reconcile many of their statements with respect to the character of clear and confused, adequate and inadequate ideas, by introducing a distinction between the formal qualities with which the mind is apt to clothe its conceptions, and the material qualities which arise solely from the nature of the objects themselves[2]. This distinction forms the basis of the two branches of his logic; formal conceptions being connected through abstract principles with demonstrative reasoning, while those of a material character are allied with experience, and give rise to the functions of induction. The principle of causality is the guide of the second, the negative process that of the first. He attempts to reconcile the discrepancies of Aristotle between these two orders of truths, by showing how universal propositions are connected with particulars by the scaffolding of inductive inference which Bacon had designed; though Wolf failed to unite the two methods under one criterion of evidence. The intuitive

[1] Wolf published, in 1710, a small treatise on Logic, under the title of Vernünftige Gedanken von den Kräften des Menschlichen Verstandes; but his great Latin treatise on the subject, from which our references are taken, did not appear till twenty years later. [2] Logica, pars. i. § 2, c. 1, 2, § 77—116. Psychologia Empirica, i. § 30—35.

judgments which underlie each mode of proof, are distinguished with sufficient clearness; the several uses of hypothesis determined, and the laws of causality traced out with the practised eye of a metaphysician[1].

Notwithstanding the completeness, simplicity, and precision of these views, Wolf has been charged with investing simple truths with all the pomp of demonstration[2], and with converting the proof of ordinary facts into theorems of geometry. But these attempts arose from a desire to bring the complex parts of his treatise into logical symmetry, by connecting them with rational criteria, and by making the inductive and demonstrative methods coalesce and verify each other as much as possible. In furtherance of the same simplification, Wolf had asserted the homogeneous character of the speculative and mathematical branches of deduction, supposing that as the whole series of geometrical proof could be drawn out in syllogistic array, to which, indeed, he attributed their cogency; so the whole chain of philosophical inference admitted of the same rigorous precision as those of quantity[3]; a statement which was subsequently challenged by Rudiger, on the ground that mathematics embraced probability, but philosophy the transition from the possible to the real[4].

Among the opponents or followers of Wolf, we meet with few marked contributors to logical science till the time of Lambert. Rudiger introduced the logic of analogy, so much neglected by the moderns, and entirely passed over by the ancients; and Walch pointed out the extensive application it might receive in the various branches of the moral and natural sciences[5]. Crousaz, who wrote his treatise on the principles of Bacon and Locke, contributed an excellent chapter on probability and on causality[6], in which he attempted to rectify the peripatetic classification by substituting an exact category of all the relations to which the

[1] Logica, pars. ii. § 2, c. i. 2, § 662—709; c. 3, § 727—728; Discur. Prelim. c. 4, § 126—129. [2] Galluppi Lezioni di Logica. Wolf certainly attempts to define existence, but he does so against his own rule. [3] Discur. Prelim. c. iv. § 139. [4] De Sensu Veri et Falsi, i. 4; Halle, 1709. See also, for nine other specific differences between the two sciences, Crusius' treatise, Weg zur Gewissheit Vorbericht, § 10. Leipsic, 1747. [5] Phil. Lex. Einleitung in die Phil. i. c. 3, § 14; ii. c. 1, § 25. [6] Logique, part i. § 2, c. 6.

word cause may be applied, with their respective distinctions; putting forth similar views of the science to Crousaz, Père Regnault made a successful attempt to popularise logic, by expounding it in a conversational form[1]. His book, written in a clear and sketchy manner, in imitation of Fontenelle, was issued in a spirit of compromise, being an attempt to reconcile the old notions on logic with the empiric principles that domineered over his age.

But the most important accession to logic at this epoch was the introduction of a scheme of notation calculated to reduce its method to algebraic simplicity, an improvement which grew out of the ancient constitution of the science, and destined to be prolific in great results. Aristotle had conceived that the combinations of abstract ideas in reasoning might be reduced to a certain number of formulas, and that ideas might be distributed into certain classes. Hence sprung his rules for the syllogism, his categories, and common-places. In the middle age, Raymond Tully had founded his combinatorial art on the development and abuse of this great conception. Wilkins, Athanasius Kircher, and Dalgarno flattered themselves they were possessed of the power to represent the entire system of our ideas in a language competent to produce all their analogies. An attempt was now made to apply the same notion to logic, by giving that science the form of mathematical calculation, and investing it with the rigour of its methods.

With this view Plouquet introduced, and Lambert perfected, a system of particular signs directed to express the logical relations of ideas. Following Locke, Lambert[2] first endeavoured to determine the signs of the relations of simple ideas, and left those of the complex ones to be determined by the combinations of their elements. The identity of pro-

[1] La Logique en forme d'entretien ou l'art de trouver la vérité.
[2] Published his views in the *Neues Organon* and *Architectonic* (1764); the former work embracing the rules to which the form of scientific knowledge can be reduced; the latter fixing the general notions which are to constitute their matter. The first work comprises four divisions, viz. Dianoiologie, or the art of thinking; Alethologie, which considers truth in its elements; Semiotic, which assigns to truth its exterior characters; and Phenominology, or the distinction between appearances and reality. His *Architectonic* relates to metaphysics, and is consequently out of our plan.

positions in his system is represented by the sign of equality. The relations of genus and species by exponents varying in power proportionate to the extension of the distinguishing difference; and those of opposition, of analogy, of quantity and quality, of the known to the unknown, are expressed by other marks analogous to those of algebra. As there are in logic simple as well as compound relations, this theory has its corresponding proportions and progressions, and assigns to logic its series and limits as well as to the higher algebra[1]. But the greater part of the notation lies open to all the objections urged against investing matters of moral speculation with the rigorous precision of quantity, and has, in fact, remained unenforced unless by one or two stray logicians who, like Condillac, made the homogeneity of the two classes of truths the groundwork of their system. The scheme, however, led Euler[2] to devise a system of figures solely restricted to represent the logical relations of our conceptions, apart from any assumptions of particular doctrines, and prepared the way for Sir William Hamilton's mode of notation, which, by enabling us to render the equivalent and convertible syllogisms in the different figures at a glance, according to extension or intention, has simplified all the relations of pure logic, and would form, were it not narrowed to a particular system, one of the most important features in its progress[3].

Since the fall of the Wolfian system, and the inauguration of a popular literature in Germany, logic has gradually subsided in that country into a history of dreams. Even such scientific logicians as Platner and Schulze, who knew

[1] Versuche einer Zeichenkunst, in Lambert's Logische und Philosophische Abhandlungen. Berlin, 1787. See also Fragment 4. [2] Lettres à une Princesse d'Allemagne. [3] Lambert is the only logician who has attempted to complete the unfinished parts of Bacon's method, as projected in the Novum Organon, b. ii. aph. 21. He is also commonly reported to have substituted the four dicta of the syllogistic figures in the place of the dictum de omne et nullo laid down by Aristotle as the condition of all perfect inference. Prior Anal. i. ch. 5 and 6. See Mills' System of Logic, vol. i. p. 232; Buhle's Geschichte, vi. 543; and Troxler's Logik, ii. p. 62. But Thompson contradicts these authorities in assigning the invention of the three first dicta to Keckermann (Logic, iii. ch. 7—9), whose work appeared a century earlier. Thompson's Outlines of the Laws of Thought, p. 245.

the importance of maintaining the independence of their art, bound it up to a great extent with empiric psychology; while more audacious thinkers have confounded its axioms and rules with a mass of metaphysical hypotheses, framed for no other purpose than the invention of argument to contradict common sense. Yet, with a view to clearness and propriety of thought, it is evidently necessary that every science should be treated strictly on its own grounds, and most scrupulously distinguished from the sciences which lie upon its confines; while it is no less essential to the progress of knowledge that those mental phenomena which admit of irrefragable proof, and stand upon a certain foundation, should be separated from a heap of supposititious paradoxes, whose leading object appears to be, to deny what is, and to prove what is not. Kant felt the truth of these views, and in his new philosophy assigned to logic its old limits, but his[1] successors have found in his doctrines principles which impugn this division, and their final development by Hegel has terminated in a position which tears up the old logic by the roots, introducing as the criterion of truth the very tenet that it upheld as the test of falsity[2].

In Italy a few excellent treatises have appeared on the science within the last hundred years; among which the works of Genovesi and Galluppi[3] stand conspicuous for completeness, precision, and exactitude. Though they follow Wolf in applying the mathematical methods to the speculative sciences, they do not invest them with the same degree of certainty; but as evidence admits three classes of truths,

[1] Critik, p. 74. See also his Die Wissenschaft der Verstandes regeln Uberhauft. Kant's Logik was a posthumous work, and compiled at his request from his own papers by Gottlob B. Jahsche. The introduction is longer than the entire work, and contains little worthy of remark beyond some formal distinctions, principally designed to separate pure from applied logic. [2] It is idle to attempt to refute a man who assumes the livery of falsehood as the badge of truth, and who asserts that, when you have involved him in a contradiction, you have only established the truth of his principles. It would appear that Hegel's Wissenschaft der Logik screens itself by such an assumption from any attack on the part of the old, and that there requires a logic absolutely superior to both to decide the controversy. [3] Genovesi was contemporary with Condillac and Benedict XIV. Galluppi's treatise, Lezioni di Logica e di Metafisica, was issued so recently as 1841.

viz., mathematical, moral, and sensible, they likewise discriminate the same number of certainties, and lay down criteria for their determination. This portion of their system is connected with a rigid analysis of the sources of evidence, which is resolved into intuitive perception, sensation, reasoning, and testimony[1]—a leaf taken from the scholastic logic in use among Catholic universities[2], and evidently connected with the science, though generally neglected of late years by its popular expositors. Genovesi[3], whose treatise is more original and concise, but not so profound as Galluppi, has instituted eight simple rules of a more facile and general application than those which appertain to the syllogism, which arise out of his definition of reasoning as that of developing a confused idea, so as to render it distinct in making its clear portion explain that which is confused; and condenses into a few maxims the principles which control *à priori* and *à posteriori* inference. He concludes his logic with a survey of the entire systems of knowledge in a classified form, and with an exposition of the harmony which ought to reign between their several groups, and a precise statement of their peculiar characteristics and fundamental principles.

As the views of the principal English logicians of the present century are discussed in the body of this work, we need not here go further into detail than to point out their general features, and show the different aspects which the science assumes from their embodiment. At the commencement of this era, logic, which had restricted itself to the scholastic garb, was fast declining as a study, not less owing to the sweeping censures of Brown and Dugald Stewart, than to the blighting railleries of our comic dramatists, and the feeble talents of its own expositors. Kett Belsham and Kirwan[4] only repeated what had been said as well, if

[1] Galluppi adds memory and evidence, but subsequently resolves memory into an auxiliary agent of the others. Evidence is plainly no faculty, but simply the result of the legitimate exercise of the mental faculties in reasoning. [2] The most methodical treatise of this class, and surpassing all others in the completeness of its views, is one by Professor Ubaghs, of Louvain. [3] For his logical views, see Elementa artis Logicæ Criticæ and his Della Logica. Venice, 1799. [4] Belsham's Compendium appeared in 1801; Kirwan's Elementary Logic in 1807.

not better, before them by Crackenthorpe, Wallis, Saunderson, and others; and it appeared that the Aristotelian form of the science was on the point of being restricted to scientific theology, had not an advocate of colossal dimensions, Archbishop Whately, stood forward to re-assert its empire, and answer the Scotch professors with arguments quite as striking as any which they had urged. The work achieved its object. A host of treatises appeared, more or less embodying its principles; two or three, of course, in the natural order of things, venturing on a condemnation[1]; and the science experienced a revival which has, during the interval of a quarter of a century[2], manifested no signs of abatement.

The great object of Dr. Whately is to extricate logic from the false views with which it had been connected, and defend and expound its doctrines according to the limits assigned to it by the scholastic divines. With regard to method in the Cartesian sense, or to the trains of thought which have led philosophers to grasp the highest axioms of science, logic has nothing whatever to do. It simply confines itself to analyse and determine the reasoning process so far as it is a verbal operation[3]. Beyond this Dr. Whately will not admit the possibility of an abstract science of evidence, the field being too large and multifarious to permit the methods pursued in each science to be succinctly generalised. Hence, if a reader wish to have any idea of the processes by which the mind is led to attain truth, or to appreciate their relative force, he has no other resource than to attack with Leibnitz the entire group of the sciences, and familiarise himself with the encyclopædia of knowledge. Of the general theory of inference he can know no more than what Aristotle told him some two thousand years ago, when reason had made but a few ill-digested efforts to explain man's position in this world,

[1] Among the former may be mentioned Hind's "Introduction to Logic," and Hill's "Artis Logicæ Rudimenta." Dr. Whately's excellent treatise, however, experienced severe strictures in the critical examinations of G. C. Lewis, Bentham's New Outline of Logic, and in one of Sir W. Hamilton's essays. [2] Dr. Whately's Elements appeared in 1825. [3] "Logic is entirely conversant about language." "It is the art of employing language properly for the purposes of reasoning."

and when its highest results were to be found in the victories of the sophist. It is evident such a statement must be received with caution. Had Dr. Whately confined his remarks to those who confounded metaphysical discussions, mnemonic aids, and educational suggestions, with the science of inference, his censures would have been as applicable as they are forcible; but to strike at those who claim for logic the analysis of all the methods of inference which reason employs in the investigation of truth, and limit the science to that part of it which the deductive syllogism involves, is arresting generalisation in logic at a stage when it was manifestly impossible that it could be otherwise than imperfect. Even the *à priori* forms of the logical faculty cannot be correctly analysed without a distinct reference to the tangible facts about which they are employed[1], and when Aristotle wrote, physical science was a blank, and law and theology were unborn.

An attempt has been made to supply a logic embodying the leading forms of inference pursued in the chief departments of science by John Stewart Mill, whose treatise is, perhaps, the only one which presents an adequate conception of the science[2]. Were it not for the ultra-nominalist theories of the author, and his disposition to regard material objects as the only things to which real inference can be applied[3], his work, we doubt not, would have been one of the most perfect expositions that logic, as the science of inference, could have received at the present day. He sees distinctly through his subject, exhibits compact and consecutive thought in harmonising its various details, and withdraws the mind from too much attention to empty formulas and trifling distinctions, which is the bane of the peripatetic logic, and fixes it on the realities of nature. In expounding the theory of induction, which he makes the

[1] In proof, we refer the reader to Aristotle's Theory of Induction.
[2] We regret, in addition, he should have referred his readers to scholastic logicians for an exposition of the laws of the Syllogism, and taken up much valuable space with frivolous metaphysical disputes with Whewel, in which his arguments only go to prove that he is on the wrong side. [3] Mill will not admit there is such a thing as inference in Law and Theology, but only interpretation.

basis of inference, ratiocination being, in his view, a dependent and subsidiary process, he takes the laws of the material world as a sort of middle term by which the methods pursued in all the sciences may be presented even to the uninitiated in a general and perspicuous form, and considers these laws under every point of view in which they are capable of shedding new light upon the processes of science. The result is a masterly analysis of the logic of the physical sciences in the spirit of Lord Bacon, whose chief merit it was to commence the undertaking. In supplying the very gap which Bacon pointed out, Mr. Mill's treatise has placed logic on its legitimate foundations, and constitutes an era in the science destined to be of paramount influence over future times.

The newest phase, however, which logic has assumed in the present century is that which arises from a thoroughgoing quantification of the predicate, which Sir W. Hamilton ventures to think will remove many cumbrous forms that now clog the peripatetic development of the abstract law of reasoning, and both simplify and extend its general results. Though this distinguished metaphysician has not yet communicated his views to the public, a general outline of them has appeared from the pen of Spencer Baynes, in the shape of a prize essay, which Sir William Hamilton, who proposed the subject to his pupils, has endorsed with his sanction. We are unable, however, to see, from Mr. Baynes's statement of his views, that the proposed alterations will effect any improvement in this branch of the science, so far as practical utility is concerned, however serviceable such emendations may be in simplifying the abstract statement of the laws of thought. Our reasons will be found in the parts of the treatise which the complete quantification of the predicate would modify, where Sir W. Hamilton's opinions are noticed in detail. De Morgan's treatise, which deserves honourable mention for its list of privative judgments[1], embodies, we believe, most of Sir W. Hamilton's views on pure logic, but the mathematical mnemonics which run through

[1] De Morgan's Formal Logic, p. 61. Leibnitz (Op. xx. p. 98. Erdman's ed.) had started, but did not continue the subject.

the whole of it, will ever tend to render it a sealed book to those not over enthusiastic about algebraic symbolism. Mr. Thompson's "Laws of Thought" is avowedly written to introduce the alterations proposed by a complete quantification of the predicate in a popular treatise on logic. But the author by no means adopts the entire doctrines of the illustrious Edinburgh professor; he ventures to think that many of the new syllogistic moods in his system are useless and nugatory. To a clear exposition of pure logic, Thompson subjoins an analysis of the scientific processes which constitute the mixed branch of the science, but in too isolated a manner. The work is lucidly written, and forms an invaluable accession to the literature of logic[1].

Notwithstanding the success of these efforts, the age has not been without impugners of the peripatetic system, who with Brown and Locke would tear it up root and branch, and hardly leave a single vestige of it in the science of inference[2]. Though their objections are strikingly stated, we meet with nothing of a very novel character in their works, nor do we think the reasons adduced at all likely to shake the empire of the Stagyrite, so long as that is confined to its strict domain[3].

[1] Outlines of the necessary Laws of Thought, by the Rev. William Thompson, first published in 1822, but has since gone through two editions. We would refer the reader to this book for a lucid exposition of the bearings of nominalism and realism. [2] B. H. Smart's Outlines of Sematology, and Mr. Samuel Bailey's Theory of Reasoning. [3] In this introduction we have been compelled to omit even the mention of many excellent treatises, such as Moberly's, Professor Newman's Lectures on Logic, and Wesley's clever little compendium, "The Art of the Syllogism," owing to the narrow limits to which our space has necessarily confined us.

LOGIC.

BOOK I.—OF TERMS.

BOOK I.

OF TERMS.—PROEMIUM.

All reasoning is founded upon judgments, and these can only be employed about the mind's conceptions of things, which enunciated in language are called terms. Hence logic, at the outset, concerns itself with the formation of, and verbal expression of, conceptions, so far as these operations concur to the deduction of correct inference. This limit, we conceive, may be as easily drawn as that which marks the boundaries of any other science in the group of those which have language as a subject-matter in common. If it is obvious that grammar has to deal with terms only as they concern correct speaking, and rhetoric only as the employment of them is calculated to excite certain emotions, it is no less obvious that in logic we must restrict ourselves to that view of them which concerns the operations of the mind in correct reasoning, and the part they play in the process. To attain this object two things are manifestly requisite. First, to trace the results of the different processes of thought to which objects must be subjected, before their relations of agreement or disagreement to each other can be adequately ascertained; the second, to examine the process by which notions and signs become the representatives of these objects, with a view to discover how far, and under what sense, the abstractions and names with which they are clothed may be relied upon as a correct designation of the properties which they imply. These two heads cover the entire ground of the Aristotelian and Baconian analysis of terms, and will, if fully developed, exhaust the subject. The first is intended to explain all that relates to conceptions with regard to their form, while the second will comprise everything which has reference to their matter. The prior member of the division naturally resolves itself into material and formal relation, the first of which will form the opening chapter.

CHAPTER I.

MATERIAL RELATION OF TERMS TO EACH OTHER.

§ 1.—*Conditions of Conception—Substance—Attribute.*

It is clear that the mind can form no distinct conception of an object without ascribing to it some property, or without receiving an impression of its existence in some mode or manner. The object which is thus supposed to exist by itself is denominated *substance;* the property assigned to it is called its attribute. Thus, in the proposition that stone is flinty, we assign the mode or attribute of flintiness to the substance—stone; and not unfrequently condense both into one expression—as a flinty stone.

The names of objects were denominated by the schoolmen substantive or absolute. The names which represent things as modified—for example, round, hard, just, prudent—as connotatives, from the Latin word *connotare* (to mark along with), because, while they point out distinctly the mode, they also *denote* the subject in which it inheres. This designation is of great use in keeping in view the distinction between the names which simply denote objects, without any reference to their attributes, such as proper names and those which imply along with them, denotation or marking out of the object, the attributes with which it is invested.

All attributes are either adjectives or substantives, generalised from them, as human or humanity; corporeal, corporeality; rational, rationality; and necessarily imply relation to some substance of which they are the mode. This relation may be either essential or accidental—that is, contingent. An essential attribute enters so far into our idea of the substance to which it refers, that we cannot conceive it to exist without incorporation with it. In this manner rotundity is essential to a circle, rationality to man, and four-sidedness to a square; since these notions invest them with the properties that constitute their being. A contingent

attribute may, on the other hand, as the term imports, exist apart from the substance to which it implies relation. Because many men are found black, it cannot be inferred that any particular colour enters into our conception of humanity[1].

§ 2.—*Abstract and Concrete Connotative and Non-Connotative Terms.*

When the mind embodies the attribute in a subject, the notion thus definitely limited is called concrete; when it views the attribute in a substantive form, apart from the object, the term is called abstract. Thus, when the property of wisdom is considered with reference to man, we get the concrete "sage;" but if we generalise the term wise, and view it without reference to the object it denotes, we obtain its abstract "wisdom[2]." All general names, however, since the time of Locke, have been denominated abstract, and common usage has conventionalised the expression; but the term was employed by the schoolmen solely to designate that large section of words which substantise attributes, and to that sense it ought to be restricted. Hence, as abstract terms generally refer to one special property, as whiteness, rotundity, or smoothness, they are designated non-connotative, since they do not imply any object beyond it.

Substances may be said to be singular when the mind employs itself about any one definitely, as this tree, that

[1] The distinction between mode and substance is not, as the Port Royal Logic asserts, that the true mode cannot be conceived apart from its relationship with the substance which it implies, while the substance can; for when that relation is essential, the substance can no more be conceived without it than the attribute. The clear distinction between attribute and substance is fundamental to correct reasoning; but it appears to us to lie in the discrimination of one property from a congeries of properties, the former of which always finds expression in an adjective form, or as a substantive generalised from an adjective.

[2] Hence abstract words generally are not capable of being pluralised, while all concrete are. A principle which led the Greeks to adopt the very elegant contrivance of using the same word to denote the general idea, while they marked the abstract or concrete character it bore by a simple alteration of the number; the plural of an abstract noun being used for the singular of a concrete. For instance, τεχνη is the abstract term for art; τέχναι the concrete designation of the particular exercise of the art. See Æsch. Agam. 249.

house, or when the thing actually existing stands apart by itself, as the city of London, the university of Durham. They are denominated general or common when they are viewed in connexion with the class to which they belong, as tree, city, university, &c. It may be necessary to distinguish general from collective terms. The former can be predicated of each individual of a multitude; a collective name cannot be predicated of each separately, but only of all taken together. Thus, Kellerman's division of infantry could not be predicated of every individual who composed it, but only of the collective body. Such a term is considered as a single collective name; but if we mention a division of infantry, without reference to any special one, the name must be considered as general and collective.

All concrete general terms are connotative. The word man, for instance, denotes an indefinite number of individuals, of whom taken as a class it is the name, but it is applied to them because they possess certain attributes: as animal life, corporeity, rationality, and a certain external form which is called human. Every existing being which possessed these attributes would be called a man; but none could be so denominated that wanted any of these qualities. If a race of animals were discovered like Swift's Houyhnhms, possessing reason equal to human beings, but invested with another corporeal form, some other name than that of man would be required for their denotation. On the other hand, most singular names are non-connotative, since they denote the individual objects to which they are applied, without implying any attribute in connexion with them. For example: when we call a boy "Edward," or name a girl "Clotilda," it is simply to enable these individuals to be distinguished from their kind without awakening in the mind any impressions concerning their attributes.

§ 3.—*Relative and Absolute, Positive and Negative Terms.*

When the mind considers any object as connected in any way with another, the term in which it is expressed is called relative. Such are father, son, ruler, subject, cause, effect, and those various degrees of comparison by which subjects

are contrasted together: as like, unlike; longer, shorter, &c. Absolute terms are those which express the object independent of such relation: as man, house, animal. When two objects which are pairs are viewed in reference to the relation they hold to each other, the terms in which they are expressed are denominated correlative. Thus: though a king is the ruler of men, king and man are not correlative, but king and subject are.

When the mind attributes any definite property to a subject, the mode so assigned is termed positive: as, a man reasoning. If the term denote that such a quality might be conceived to exist in the subject, but does not, the attribute is called privative: as dumbness, a man who is silent, a blind child. If the mode is inconsistent with the subject of which it is predicated, it is then called negative: as a dumb picture, a lifeless statue. We may notice, however, that attributes are often positive in form, while they are negative in reality. Thus: the words idle or sober, though positive in form, merely connote the absence of activity and drunkenness. Some terms, on the other hand, conceal a positive attribute under a negative form: as truthlessness does not express the mere absence of truth, but the positive attribute of lying.

Notions are said to be contradictory when they completely exhaust all nameable things: as animate and inanimate, corporeal and incorporeal, organised and unorganised; for it is impossible that one or other should not belong to every object; as there is nothing that can be both, so there is nothing that can be neither. On the other hand, contrary notions are those which cannot be predicated of the same subject at the same time, though there are many subjects to which they do not apply at all, and others to which they are applicable at different times. Nothing can be at once discreet and imprudent; but a man may be so at different epochs of his life, while a tree can never be deemed either.

CHAPTER II.

FORMAL RELATION OF TERMS TO EACH OTHER.

§ 1.—*Generalisation and Abstraction.*

The principal act by which the mind arrives at the various conceptions we have enumerated, is abstraction. By this faculty we can divide substance into its logical parts, viz., subject and attributes, and restrict our attention to any definite mode, apart from the subject in which it is supposed to inhere. This is clearly evinced by geometricians, who in treating their science do not, as is the vulgar opinion, suppose that there are lines without breadth, or surfaces without depth, but simply that they are able to consider length apart from breadth, which is even competent to the peasant when he measures the distance from one town to another.

It is obvious that by the same faculty we can detach our mind from the accidental properties of a subject, and consider its essential attributes alone. As in the case of a human being, we may withdraw our thoughts from his individual peculiarities, as height, complexion, colour of hair, &c., and attend solely to those qualities which enter into the essentiality of his being, as a particular form of corporeity endued with reason and animal life. In the same manner, when we draw a triangle on paper we are able by an instantaneous process of thought to withdraw our attention from the place where it is, and the other accidents which determine it, and consider the diagram as a figure bounded by three right lines. We thus obtain a conception which applies to all triangles indiscriminately; as in the former example, we obtained a conception which included under it all members of the human family. By fixing the results of these processes of thought in permanent language, as man, triangle, animal, we obtain the terms we have already designated common from being applicable to all the individuals included under them alike, and which are sometimes called predicables, because they can be predicated of each affirmatively.

§ 2.—*Genus and Species.*

By this process of generalisation the mind is enabled to dilate or contract its view of objects to an extent only limited by the boundaries of human intelligence. We may, by abstracting from or adding to any conception within the range of actual existence, proceed through the varied scale of being till we reach the highest or lowest link it opens out to us. Thus, by observing a particular horse, Bucephalus, grazing with others in the same field, and abstracting the essential qualities of the group from those which are merely accidental, as colour, size, age, &c., we get the common notion of horse. If again we contrast the notion of horse with cow, wolf, tigress, we observe that they have one property in common—viz., that of suckling their young, and abstracting this from the other qualities in which they differ, we form the wider conception of mammalia. Carrying the process still further, we may compare the mammalia with birds, fishes, insects, and worms, whence perceiving that all these, however different, agree in connoting corporeal life and sensation, we arrive at the wider conception animal, which embraces all material living things. In the same manner animal may be considered in relation to inanimate objects, when the abstraction of life and sensation will leave us the residuum of corporeal substance common to both. Another step will lead us to the most general conception the mind is capable of forming—viz., that of *being* as synonymous with *substance*, *i. e.* a substratum in which certain properties inhere. The mind, in its view of objects, ranges with equal freedom through the descending and upward series, and by bringing any two notions into the scale can ascertain their definite relation to each other. Thus the notion animal connotes distinct qualities, in which mammalia and insects equally participate; it can, therefore, be predicated of both; but mammalia and insects, though included in one compact term, designate different attributes in the kinds which they represent, and on that account reciprocally exclude each other.

When a notion is considered as included in one more general it is called a species, and the containing term in connexion with it is denominated genus. Thus body and mind

are contained in the notion of substance; as rhinoceros and elephant in that of animal. They are, therefore, species of which substance and animal are the genera. Things which are species to one genus may be respectively genus and species when viewed in relation to each other. Thus man and animal are species with reference to substance; but animal is the genus of man, who in turn is a species of animal. Species, however, of the same genus which mutually exclude each other are denominated co-ordinate species: as mammalia and insects are the co-ordinate species of animal. In like manner the same notion may be a genus when compared with the things to which it extends, and a species when compared to another term which is more general. Thus body, which is a genus in respect of organised and unorganised things, is a species in relation to substance; and quadrilateral, which is a genus with reference to parallelogram and trapezium, is a species in relation to figure. Such terms as are respectively genus and species, according to the light in which they are viewed, are called subaltern genera or species. There are, however, species which cannot become genera, as circle includes only individual circles which are all of the same species. These are termed *infirma species*, of which there are many kinds. But there can only be one absolute genus — *summum genus*, which is not a species; whether we choose to call it being or substance, is a point for metaphysical rather than for logical discrimination.

§ 3.—*Differentia, Property, and Accident.*

But, besides genera and species, which being the results of the general ideas that represent their objects to us as things or modes of things denoted by substantives, there are a class of notions formed by the abstracting power of the mind that have reference to objects as things *modified*, and are generally expressed by adjective or connotative terms: these, when compared with the substances to which they relate, will fall under the head of *difference*, *property*, or *accident*.

When we divide a genus into its species, as animal into horse, bird, or man, &c., we have regard to some essential attribute, which not only distinguish them from their com-

mon genus, but separate them from each other. Without such attribute, it is evident the species would be confounded with the genus, and with each other. For example, body and mind are two species of substance; but we are only led to conceive them such because body, though included in substance, is distinguished from it by an attribute which substance does not connote, viz., that of extension, and mind by that of thought: which attributes in turn serve to separate the species from each other. Now such essential attribute, whatever it be that leads us to discriminate the species from the genus, is called, as the sense implies, its difference—hence, the genus with its difference makes up our idea of species. Thus metal-wire, endued with polarity, constitutes a magnet, so that the species includes all the attributes of the genus, just as the genus includes all the subjects of the species. Or, to take a plainer instance, man is a responsible animal; the term animal (genus) includes every kind of organised being endowed with sensation, among which man finds a place; while the term man (species) includes all the qualities of free-will and reason, combined with material agency, in which the attributes of the genus, viz., organised and percipient sensation, necessarily are comprised[1].

The species, however, may be distinguished from the genus by other essential attributes besides that which constitutes the difference, and which, as the difference is generally the leading quality, is often implied in, or dependent upon, it. Thus extension is the differentia of matter, but in examining the nature of extension we find it connotes divisibility. Hence we call this quality a property of matter. Occasionally, however, a property may be something distinct from the differentia that is not implied in it, as it is an essential quality of a triangle that its three angles be equal to two right angles; but this property is not implied in the differentia which distinguishes a triangle from other figures, viz., three straight lines which enclose a space. Hence pro-

[1] Difference does not occupy a distinct place among the predicables of Aristotle, though it may be inferred from his category. See Organ. Top. ch. iv. The division of predicables in the text was first fully drawn out from his Topics, by Porphyry.

perty may be taken to be such essential attribute of the species as is not employed for its differentia.

Since the difference and property of a species must be essential to our conception of any of the individuals included under its class, it is evident that their universality must be co-extensive with it. They are, therefore, creations which depend as much upon the mind's generalising faculty, as genera and species, and are not improperly included with them in the same category. It should, however, be observed, as the mind is generally led to adopt that attribute as the differentia which is most important to the end it has in view, that which may constitute the property of a species with one may form its differentia with another. Thus, in naval science, the polarity of the magnet is the quality which would be viewed as the differentia, while by those who employ magnets for more expeditiously picking up bits of iron, this might be regarded as a property, but the attracting power of the magnet would constitute the differentia.

Any quality that does not enter into our conception of the essence of a species, but may be absent or present, that species continuing the same, is called an accident of the species. Thus a man may be walking, or he may be a Mahommetan. Of these two examples the former is called a separable accident, because it may be separated from *the individual;* and the latter inseparable, for a contrary reason. Every accident, however, must be separable from the species, otherwise it would be a property.

It is very important here to observe, that no term can be determined to belong to any of these five universal predicables unless it be specified of what it is to be predicated. For example, the term "red" would be considered a species with regard to colour; a *genus*, in relation to the terms "pink," "scarlet," &c. It might be regarded as the *differentia* of "red rose," as a *property* of "blood," and as an *accident* of "a house." Thus the power of resisting oxidisation is an accident in reference to the term metal, but it is a property of gold and several other metals; and hence we may infer that, in all cases, the differences or properties of any lower species will be accidents in reference to the higher class in which they are comprised.

§ 4.—*Extension and Intension.*

By examining the relations which genus and species bear to each other, and the different natures of the wholes by which one is said to be included in the other, we shall distinguish a very important law of abstraction. It is evident we cannot detach any properties from a notion without extending the list of objects to which it is applied. Thus, if we abstract from a rose those peculiar properties which constitute its essence, and attend solely to those which it connotes as a plant, we extend its application, before limited to flowers with red petals, to the oak, fir, lichen, geranium, and a countless variety of others. This view of a conception, restricted solely to the number of objects it denotes, is called its extension. But, in proportion as we extend the application of a notion to denote a greater number of objects, the notion must necessarily comprehend fewer properties; as in extending rose to plant we dropped petals, leaves, stamina, and pistals, for vegetable growth, the only property we can assign to plant. But as we narrow the sphere of a notion the qualities which it comprehends proportionably increase. As in restricting the term body to animal, we are obliged to endue it with the qualities of life and sensation; and if we still further narrow it to man, we must comprehend reason in the list. This view of a conception in relation to the properties it connotes is called its comprehension.

Hence the comprehension of a notion is always in the inverse ratio of its extension; the maximum of the one being necessarily the minimum of the other. This arises from the different nature of the counter wholes which these quantities represent, the one comprising an assemblage of attributes, the other of objects; the one a concrete, the other an abstract whole. Thus in the individual when the greatest number of attributes is united, comprehension is at its maximum, and extension at its minimum; while in the most abstract notion the mind can form, viz., that of being, extension is at its maximum, and comprehension necessarily at its minimum, since it only connotes the single attribute of existence[1].

[1] Bayne's translation of the Port Royal Logic, 2nd ed. note 17.

§ 5.—*Nature and Rules of Logical Division.*

When we enumerate all the co-ordinate species included in a general term, or, in other words, when we state in full all the objects which such term denotes, we are said to subject it to a logical division. Such a process is, in fact, identical with the statement of a conception in terms of its extension[1].

Dr. Whately, with all deference to such high authority, confounds, as it seems to us, the operation of narrowing a term to certain attributes, with the statement of the objects which are included under it, in calling the process by which we obtain a logical division the reverse of generalisation[2]. This can hardly be correct in the majority of cases; for in that process we abstract not objects, but attributes of objects. So that the inverted operation would lie in the annexation of the abstracted attributes; that is in the narrowing a term to a smaller circle of objects, by increasing its definitive properties. We need hardly say that such an operation is widely distinct from enumerating the several kinds of objects denoted by a common term, which is the main branch of logical division. Thus, body may be divided into stone, plant, brute, man, and other things, which form its co-ordinate species. In the same manner organised substance may be divided into plant, brute, and man, which are contained under its extension as subject parts.

This mode of division is regulated by rules. The first is, that it be complete; or in other words, that all the parts, or members, must be exactly equal to the thing divided; as even and odd comprehend the whole extent of the term number, there being no number which is not included under one of these branches. It is a common error with the schoolmen to assume an incomplete for a complete division; and having limited the subject to their own category, to argue as if the thing discussed had no existence beyond it. The mistakes in

[1] A conception, however, is capable of being divided into the qualities which distinguish its co-ordinate species from each other. As every animal is rational or irrational, every line is straight or curved, every substance is organised or unorganised, material or immaterial, &c. [2] Logic, p. 151, 7th ed.

these cases appear to have arisen from taking terms in a contradictory sense, which were only contrary; and also from dealing with subjects so vague and abstract as to defy human intelligence to fix them by any exhaustive denotation. Thus, if one divided spirit (in its rational sense) into human, angelic, and divine, and discussed its properties as if restricted to the beings whom those terms denote, his inferences concerning them would be open to grave doubt in a philosophical point of view, since we have no scientific data to confine the existence of such a principle to such tripartite sphere. Again, did a philosopher divide men into ignorant and learned, or a theologian into virtuous and vicious, a physician into diseased and healthy, the least discerning would immediately perceive that, if they dealt with these branches of their subject as including the entire of the human family, a serious error would be committed. For there is a certain medium of knowledge which removes a man from the rank of the ignorant, though it does not place him among the learned; between virtuous and vicious there is a medium state, to which we may apply what Tacitus said of Galba, "*Magis extra vitia quam cum virtutibus*[1]." For there are many who are excluded from vice by the same inactivity which prevents them from doing good. Between diseased and healthy there is the state of convalescence and of the man ailing, and so with numerous others.

Ramus, to ensure obedience to this rule, reduced all division to a twofold form, which should exhaust the subject at every stage of the process. This form did not, as is expressly asserted by Reid and others[2], originate with Ramus, but was frequently employed by Aristotle[3] and the scholastics, whenever the subject seemed to invite its application. This division proceeds upon the principle, that a term, along with its contradictory, comprehends everything. Thus substance may be divided into material and immaterial; material into organic and inorganic; organic into percipient and non-percipient; and the repetition of the process, so as to carry on the subdivision to the required length, is called by phi-

[1] Hist. i. 49. [2] See Reid's Analysis of Aristotle, art. Categories. It is curious to observe a divine analysing an author whom he seems never to have read. [3] The Stagyrite, however, condemns the procedure as useless for scientific discovery. Anal. Post. ii. ch. 5; An. Prior, i. ch. 31.

losophers *abscissio infiniti*. Though this bifurcate division is cumbersome, from the vast quantity of subdivisions to which it leads, and also obscure, since it leaves us entirely in the dark with regard to the properties of the most extensive member of division, there are many cases in which it can be turned to account in scientific discovery[1].

The second rule which a logical division ought to observe is, that the constituent members must exclude one another, on the principle of the division which formed the logician's point of departure. Thus, if a naturalist were to throw light on the horse tribe by dividing them into Arabic, French, English horses, racing horses, waggon horses, grey horses, chestnut horses, cab horses, &c., no one would give him credit for any distinct knowledge of his subject. Yet, ludicrous as this division may appear, there are not wanting instances in which the greatest philosophers, through losing sight of the mutual exclusion of the dividing member on the ground of one unique principle of division, have committed follies quite as absurd in the higher walks of science. Thus Bacon, without any distinct point of departure, divides motion into every conceivable kind that can be presented to the eye[2], or even entertained by the mind, without any distinct idea of what he is aiming at, save a loose cataloguing of every sort of motion on which a distinct name could be fixed. In this way he enters into an elaborate detail of motions of pressure, motions of coercion, motions of liberty, motions of art, motions of union, motions of strife, and a dozen other kinds of motions, equally homogeneous, which, like the above ludicrous division of the horse tribe, present no real difference in kind, and are capable of being affirmed of the same subject. Some of Aristotle's divisions are equally trifling and absurd[3].

As any subject may be considered in a variety of ways, it is

[1] As to what respect, see History of Logic, Ramus, p. 10. [2] Novum Organ. book ii. app. 48. His division of methods, in the 6th book of the De Augmentis, not much better. Bacon was endowed with a spirit eminently nomenclative, which led him to throw everything he treated into tables; but though he continually reproaches the scholastics with confounding the essential differences of things, he never ceases to commit the same fault himself. [3] An instance of illogical divi-

necessary to understand the object we have in view in subjecting it to a division, and allow that to be our guide throughout. Thus horses would be divided by an agriculturist according to their uses; by a naturalist, with reference to their tribes; but these two principles could not be introduced in the same division without giving rise to confusion, by running the dividing members into one another, and defeating the object of logical division altogether. In like manner the division of a library could not be undertaken without some precise notion of the principle of the arrangement. If books are to be divided according to their sizes, we understand that folios will comprise one section of the subject, and quartos and duodecimos two others. If the matter of which they treat is to form the basis of the arrangement, all know that history, fiction, theology, and the leading branches of science, will form the prominent members of the division. But should the language in which they are written be the ground of the division, the dividing members are still more obvious.

It is not necessary that the dividing members absolutely exclude each other, but only in the point of view upon which the division is framed. Thus writers of fiction may be divided into poets, dramatists, and novelists; but the members of such division, though mutually exclusive, as far as the kinds

sion—quite as flagrant as either of those just given—was furnished by Watt, in that very part of his Logic written to guard his readers against it: "Furnish yourself," said he, "with a rich variety of ideas; acquaint yourselves with things *ancient* and *modern;* things *natural, civil,* and *religious;* things *domestic* and *national;* things *of your native land* and *foreign countries;* things *present, past,* and *future;* and above all, be well acquainted *with God* and *yourselves;* learn *animal nature* and the *workings of your own spirits.*" To which he adjoins the very sapient remark, that so complete an acquaintance with things in general will be of very great advantage. To the success of Watt's Logic, which is one of the most widely circulated books on the science in the English language, may be ascribed much of the prevalent confusion about logic. It is a bad compound of the worst parts of Locke with the worst parts of Arnauld. Watt seems to have taken the chapters on the Human Understanding and the Port Royal Logic as they came to hand, and stitched them together, without caring how the apocryphal *à priori* principles consorted with the crude experimental notions, so as he made a book out of them. The elder Degerando sets down this work as the text-book at Oxford.

of imaginative writing are concerned, which is the principle of the division, does not imply that some poets may not be novelists, or some dramatists writers of romances.

The reader will observe that division, in a logical sense, has a far different signification to the separation of the component parts of a thing which is its natural meaning. We divide a flower into leaves, stamens, and petals, each of which is much less than the whole; but in the metaphorical sense of the word which logic implies, each member of the division is in reality greater than the whole, for we cannot assign to the genus flower its constituent species—rose, geranium, tulip, &c., without expressing, in addition to the general notion of the term, the peculiar differences which separates one species from the other.

§ 6.—*Examples of Division. The Categories and Predicables.*

The most complete examples of logical division are furnished by Aristotle, in his enumeration of everything that can be made the subject or the predicate of a proposition, and of all the possible relations which the subject and predicate can have to each other. The former class are denominated categories or predicaments, and muster every object of human apprehension under ten heads; so that, as every soldier belongs to some company, and every company to some regiment, in like manner all the notions that enter into the human mind have their place in one or other of these categories, and by proper subdivision may be drawn up in rank and file, and passed under review[1].

[1]

Being.	Substance (1).		
	Mode of substance.	Absolute.	Matter—*i. e.* quantity (2).
			Form—*i. e.* quality (3).
		Relative (4).	Action (5).
			Suffering (6).
			Where (7).
			When (8).
			Posture (9).
			Habit (10).

We have given Sir W. Hamilton's distributions of the predicaments, as the most perfect that can be selected. See his edition of Reid's Works, p. 687. A humorous illustration of the categories is given by Cornelius to his pupil, Martinus Scriblerus. Cornelius was forced to give Martin sensible images: thus calling up the coachman,

This division, commonly known by the name of the five predicables, expresses every conceivable relation of subordination or co-ordination to which the forms of inference necessarily subject these classes of predicaments. So far our treatise on terms has hardly consisted of anything else than an explication of them, as the following summary will show:

Every predicable expresses either

The whole essence of the subject—*i. e.* species.	Or part of its essence.	Or something joined to its essence.
	Genus—difference.	
	Property.	Accident.

Universal, but not peculiar.	Peculiar, but not universal.	Universal and peculiar.	Separable—inseparable.

If, then, the predicaments present us with every intelligible notion, the predicables reveal all the conceivable modes in which these notions can be compared together. The categories delineate the boundaries which intersect the vast region of human knowledge; the predicables state the result of those laws of thought which lead to their discrimination. The one presents us with all the objects cognisable to human intelligence; the other, with all the forms which characterise the operations of that intelligence in dealing with them. The one reveals the compartments under which the phenomena presented by nature may be arranged; the other, the results of the application of rational principles to the objects they represent. By the union of both, the whole furniture of the human mind is presented to us at one view, and the registry of all nameable things in the universe and of the world-embracing mechanism of thought brought within the compass of a nutshell.

he asked him what he had seen at the bear-garden? The man answered he had seen two men fight for a prize: one was a fair man, a sergeant in the guards; the other black, a butcher; the sergeant had red breeches, the butcher blue; they fought upon a stage about four o'clock, and the sergeant wounded the butcher in the leg. Mark (quoth Cornelius) how the fellow runs through the predicaments—men (substantia), two (quantitas), fair and black (qualitas), sergeant and butcher (relatio), wounded the other (actio et passio), fighting (situs), stage (ubi), two o'clock (quando), blue and red breeches (habitus).

CHAPTER III.

TERMS WITH REGARD TO THINGS.

§ 1.—*Formation of Distinct Conceptions a Part of Logic.*

THUS far our design has been simply to register the different relations which any two terms assume when their agreement or disagreement is to be ascertained; but for the comparison to terminate in a correct result, it is evident that the terms themselves must be accurate exponents of the properties for which they stand, and not as Bacon says, be rashly abstracted from things. For instance, suppose it required to be known if the quality *spontaneous* may be affirmed of the motion by which air rises out of water, it is necessary that the word spontaneous should imply some distinct property, and that the phenomenon denoted by the aqueous motion of air should be completely understood[1]. This part of the subject, viz., the obtaining clear conceptions of the terms which are brought into contrast, is obviously the first step, and the one most decisive in the investigation of truth. Without it the most perfect accuracy in the subsequent processes will but propagate error, so that we can only expect to be right by accident[2]. Yet writers on the scholastic logic relegate this branch of the subject from the science as something extraneous to its object, as if the operation of abstracting notions from things was not as necessary to the establishment of correct conclusions, as a knowledge of the relations which such notions can bear to each other, and the laws of inference to which they lead. The warmth with which this view of the science has been maintained, has driven Bacon and his followers into the opposite error of depreciating the scholastic rules and narrowing the entire scope of the science to the formation of

[1] However obvious the remark may appear, the neglect of it in the illustration alluded to, led Aristotle to lose sight of the fact that air was forced to the surface by the pressure of the water beneath, and to assert that the motion was the effect of the air seeking to join its own element. [2] See Bacon's distribution of the great instauration, and the preface to the *Novum Organum*, with note upon the context. (Bohn's Scientific Library.)

correct and appropriate conceptions, and the inductive generalisations built upon them. We, however, instead of perceiving any antagonism between the two systems, think that they so far coalesce as to form correlative branches of the same science. What opposition can there be between the operation which abstracts notions from things, and that which establishes the different modes in which such notions are contrasted together? The same mental faculty is evidently at work in both cases, and though on different objects, with the same view, viz., the eliciting truth out of the material presented to the judgment. In the first case, the mind is employed in fitting notions to objects; in the second, in fitting notions to each other. With much more reason might the craft of the stonemason, which is the preparation of stones for building, be viewed as something directly obstructive to the process of laying stones on each other, to which it is a necessary preliminary. In fact, the very subject-matter which each party claims as the peculiar province of their own view of the science, show that the ground is common between them. For what is the purport of a real definition in the scholastic sense but the adaptation of notions to convey the correct properties of things? And what principles does the physicist put into requisition in seeking the same object, but those involved in the rules of scholastic definition.

Though the distinct conceptions is undoubtedly a part, and no small part, of logic, it has its boundaries, which it will be well not to go beyond. In the first place, it is not our province to treat of the mechanism of the formation, viz., whether objects are directly perceived by the mind, or whether they convey impressions thereto by sensible or spiritual images, or whether such impressions are only modifications of the percipient mind; nor is it our business to enter into the origin of abstract ideas, and consider how far they are conceptions of general properties, or generalisations from individual groups, or in what light their existence may be considered as restricted to the human mind, or as existing in that of the divine artificer; for all these questions involve metaphysical theories, concerning which the greatest minds have differed, and are quite extraneous to logic, which deals with principles about whose cogency there cannot be the

slightest doubt. With that branch of the formation of conceptions we have to do, not which treats of the mechanism of our conceptions, but of the principles and rules by which their trustworthiness may be ascertained, as exponents of clear and definable objects. But since this view is so extensive as to embrace, in some measure, the entire scope of logic[1], it will be necessary to limit it at this stage to that part of the process which concerns the mere obtaining materials for inference. We shall therefore, at present, confine ourselves to pointing out the characteristics of distinct and indistinct conceptions; the leading sources, including language, from which such marks arise, and how far definition confirms those which are clear, while it disperses unsettled or indistinct connotation.

§ 2.—*What Class of Terms are liable to Indistinctness.*

And here it is necessary to refer to our distinction between the denotation and connotation of names as fundamental to the subject. It is evident when we point out any special object, as this book, that table, we imply—*i. e.* connote, no peculiar properties proposed by that object, but merely point out—*i. e.* denote, the thing itself. Hence all singular names, with few exceptions[2], or general names used in a singular sense, being employed not to convey information concerning the objects they denote, but simply to point them out as things towards which the attention is directed, never

[1] Genovesi correctly remarks that all reasoning is nothing else than the dispersion of what is confused and indistinct in a term by that portion of it which is defined and clear. Hence, if some limit was not introduced in the exposition of terms, it would absorb the entire field of logic. The boundary drawn in the text is taken from Whately (book ii. ch. i. note). But Reid (see his Hist. Arist. Organ. p. 686, in the recent edition of his works by Sir W. Hamilton) is disposed to allow no place to terms in logic at all, only with a view to, and so far as is necessary, to the explanation of propositions, and these latter again only so far as is indispensable to the knowledge of the syllogism. But this distinction, however consonant to a system of formal logic, is too wire-drawn for the purposes of practical utility.

[2] The connotative individual names alluded to are sun, God, or such as from the form of expression lead to the implication of some attribute; as the first King of France, or the present Chancellor of the Exchequer; yet the latter names are used generally in a strictly denotative sense.

fail to attain their object, and can be in no instance the cause of confusion in our judgments. They involve no abstraction of words from things, no wrapping up of multiform properties in one expression, like individual complex or concrete general terms, and, therefore, do not require any elucidation at the hands of the logician. There is another class of terms equally exempt from notice in this place; viz., those which are abstracted from one branch of the concrete general terms we have mentioned, as rationality from rational, corporeity from corporeal, whiteness from white, because they do not generally connote any attribute distinct from the abstract name they denote; or, if they do in some instances, it is only as names restricted to an individual sense simply by virtue of the process by which the general concrete term is formed. It is, therefore, on individual complex and general concrete terms alone that the attention of the logician must be concentrated, as the central points of confusion in erroneous judgments, since connoting several properties, they are liable to be imperfectly known, and not only seen in partial lights, but connected with objects with which they can have no relation. Thus iron, one of the simplest of this class, conveys a widely different notion of its properties to one who has heard of magnetism than to another in a contrary predicament. The vulgar who regard this metal as incombustible, and the chemist who sees it burn with the utmost fury, and who has other reasons for regarding it as one of the most combustible bodies in nature; the poet who uses it as an emblem of rigidity, and the smith and engineer in whose hands it is plastic and moulded like wax into every form; the jailor who prizes it as an obstruction, and the electrician who sees in it only a channel of open communication, by which that most impassable of all objects, the air, may be traversed by his imprisoned fluid, have all imperfect and some conflicting notions of the word[1]. And so it is with other complex terms; some are indefinite, as hard or soft, light or heavy, and others so intricate, as life, matter, instinct—as to mock every attempt of science to unfold their entire connotation.

1 Sir John Herschel, Discourse on the Study of Nat. Phil. p. 20.

§ 3.—*How Conceptions become Distinct and Confused.*

Though this class of terms are, in the generality of instances, formed for us, and in no case do we create them except in discovering or combining new truths, it is hardly possible for us to attain any clear insight into the causes of their distinctness or ambiguity but by analysing their composition, and closely watching their growth in the mind. To commence with some of the simplest examples, it is evident that the word man implies an assemblage of properties, which the mind, through the faculty of abstraction, has first detached from the accidental qualities of the individual, and then bound up into a conception which equally represents any member of the human family. Each of the properties which form the aggregate of the conception are known, and possess marks which not only discriminate it from others, but lay open its own nature and constitution. The notion man is, therefore, called clear and distinct, since we know all its properties, viz., rationality, corporeity in a certain shape, animal life, &c., and can, upon a minute survey, adduce the marks by which these properties are so constituted. Take another instance, that of matter. This term also implies a congeries of properties, some of which are as distinctly ascertainable as those included in the last example. It is evidently an extended substance, composed of divisible particles, which are constantly undergoing change according to regular laws; but we can scarcely predicate further concerning it with safety. It has its accidental as well as its essential qualities, and, to a certain extent, these can be pointed out. For example, it must be extended, though this may occur in any diversity of form. Colour and shape are alike indifferent to it. It may be animal, vegetable, or mineral; but it would be hazardous to range its gravitating property in the same category to call it essentially inert, or deny its incompetency to be invested with the attribute of thought. Hence our notion concerning its leading properties are incomplete, and to predicate anything of them with dogmatic certainty would only expose us to error. We know, however, sufficient of its properties to distinguish it generically from mind, and to divide it into many subordinate species. The notion is clear since

it communicates a distinct conception of its object, but imperfect or inadequate to realise everything that it contains.

It is evident that such examples could be enlarged until they embraced the entire gradations of clearness and indistinctness in ideas; and though the boundaries fade by imperceptible degrees into each other, philosophers have determined the classes, which they divide with sufficient precision to assign to them the marks by which they may be distinguished. On examining, however, any of their tables, we find only one generating principle of the degrees of clearness or indistinctness they contain—viz., the capability of resolving any subject that may present itself into its constituent elements, and decomposing these until the elements of their elements can also be resolved, and we arrive at the simplest analysis. Thus, the classification of Leibnitz[1], which is the most popular, will tell us that those notions are most obscure whose qualities are so impalpable that we cannot distinguish them from others; that confused notions, though they admit of such clear discrimination, are perfectly insoluble with respect to their own nature, while those ideas can only claim the privilege of being distinct and adequate whose properties can be resolved into others whose natures are known[2]. Now this is only a more particular way of stating the general proposition that notions are clear and appropriate to the objects which they represent in proportion as they unfold their specific properties.

§ 4.—*Double Mode of Resolving Conceptions.*

The general principles which preside over the process is ordinarily pointed out by the source from which our conceptions arise, there being a wide difference between the determination of ideas which refer to sensible objects and those which represent spiritual and abstract ones. It is evi-

[1] Opera Philosophica. Erdman, p. 79. Opera Omnia Dateus, ii. p. i. p. 14. First published in the Acta Eruditorum, 1681. [2] If the elements into which an idea can be resolved are unknown, Leibnitz terms it inadequate. His classification will consequently stand as follows:

Notions.	{ Obscure,		
	{ Clear.	Confused,	
		Distinct.	Adequate,
			Inadequate.

dent that, with regard to objects of sense, the accuracy of our notions will depend much upon the results of experience; while the nature of those which refer to subjects purely abstract and spiritual, must be sought from inferences struck out of the primordial elements of the mind. The sources of the first are simple facts derived from objects alien to the intellect, through the channel of sensation; those of the second are pure cognitions, either intuitive or obtained by formal inference, from principles bound up with the nature of the mind itself, and forming part of its constitution. Now, the method of obtaining accurate conceptions of material phenomena is either by analysing or dissecting the facts to which they refer, and seeking to educe out of the points of resemblance and difference some determinate notion of their elementary properties; or by forming such hypothesis as appear to suit the circumstances of the case, and then testing its legitimacy by using such verifications as the nature of the phenomena admit. The mode of gaining an adequate knowledge of the second is, by tracing their growth in the mind and fixing their accordance with the intuitive principles out of which they spring.

If we confound the principles according to which each of these two classes of ideas are invested with distinct appropriate connotative powers, our subsequent judgments are certain to be false in the precise proportion of their accuracy; or, in other words, we can only expect to escape from the consequences of the wrong conceptions we have formed by a counter error in contradicting or affirming them of each other. Thus, when Aristotle, induced by the abstract perfection of circular motion was led to assert that all the planets moved in perfect circles, he falsely applied, without looking at his facts, an ideal conception to account for a certain mode of their existence, and could only escape from the consequences of this misconception by mistakes in his subsequent deductions; or when Bacon restricted the *summum bonum* to the subjection of the individual will to that of the community[1], he applied a principle founded upon experience, to explain an idea which, being purely native to the mind, no facts can reveal to us, and thus gave rise to a false system of ethics[2].

[1] De Augmentis, b. vii. ch. 2.

[2] The utilitarian philosophy.

The application of abstract principles, whether real or supposititious, which cannot be brought to the touchstone of facts, to explain the properties of natural objects, has been one of the great sources of all the errors which have hitherto obstructed the progress of physical science. While the phlogistic doctrines of Becher and Stahl were assumed to account for all the phenomena of chemistry, no attempt was made to bring the objects of that science to the test of experience, and connect them with number, weight, and measure. While the notion that nature abhors a vacuum was accepted as a perfect explanation of the rise of water by suction, no essay was tried to determine the properties of the air; and while the geometrical conceptions falsely attributed to the circle were deemed sufficient to determine the relation of forces in the lever, the principles of mechanics could not assume a rational basis.

Though the contrary error of introducing empirical principles into moral subjects, and of seeking to resolve happiness, integrity, and similar ideas into the results of mere outward experience, is less palpable, it has been at the bottom of all the errors connected with false systems of ethics, politics, and theology. Hobbes, for instance, when he resolved the idea of natural right into brute force, was necessarily led to frame a system of government which, if practically carried out, would have transformed a subject into a slave, and a king into a despot. When Hume, in like manner traced all our notions of virtue and vice to the experience of the effects which society feels from their influence, he founded a system of ethics on an empirical principle, which completely subverted the moral nature of actions, and made adultery intrinsically as innocent as going to church. Machiavelli could not restrict himself exclusively to the past in drawing out fundamental maxims of political wisdom, without impugning some of the plainest instincts of justice; nor could Mahomet, or any of the Grecian seers, frame a system of religion to flatter the results of man's sensible experience, without introducing depravity into Olympus, and making its denizens the mere roués of pleasure[1]. It is obvious that

[1] Thus Plato's doctrine of ideas, as an Oxford logician (Mr. Karslake) correctly remarks, is perfectly true on the side of moral truth, but he unhappily extended his doctrine to truth at large, and hence all the

the greater part of the conceptions to which these subjects relate being written on the heart of man, cannot possibly be ultimately based on experience, and to attempt exclusively to extract them from the latter source while we leave their true fountain unsealed, tends to disenchant man of his high conceptions, and, even when not practically carried out, to lower art, and in a proportionate degree to degrade his being[1].

Conceptions, when so applied to unfold the properties of objects which exist in an entirely different sphere, may be properly denominated false; but there is a class which, though as fruitful in erroneous judgments as the ones to which we have adverted, arises from a superficial examination of the properties they would connote. Thus Aristotle, when examining the subject of motion, for once drew his attention from abstract principles to concentrate it on the facts he sought to explain; and perceiving that bodies fell to the ground as it were spontaneously, and that flame appeared to ascend, and bubbles of air to arise in water by the same means, he called such motions natural, as they all seemed to arise from a spontaneous movement of each body towards its own place, in order to mingle with their kindred element: while other motions never occurred without the impress of an external force, and when reluctantly set in action always manifested a disposition to cease. On comparing these motions with each other, he found they also agreed in one property quite opposite to the former—viz., that of motion from their own place; and denominating the latter violent in contradistinction to the former, he flattered himself he had rendered a complete and satisfactory account of the matter. Now had Aristotle only extended his list of motions apparently spontaneous, to include that of the earth and the planets; or to that of a fog rising from a lake when the motion takes place

empiricists were in arms against him; while Aristotle's doctrine of the experiential origin of every idea was perfectly true of the physical sphere; since there is no idea of man in our mind beyond what is obtained by abstraction and generalisation from external nature. But he extended his doctrine to universal truth, and denied that goodness or virtue was an idea in any other sense than a generalisation from past experience, and hence the outcry against him of all who were anxious for the immutability of moral truth.

[1] The general methods and rules for developing these two classes of conceptions will be given in the fourth book. See § **Analysis and Synthesis**.

in a contrary direction to what his theory would indicate; and had he submitted his instances of spontaneous motion to minuter examinations, and discovered that many—like the bubbles of air, for instance—did not rise of their own accord, but impelled by the force of the stronger element with which they were in contact; he would also have discovered that his terms natural and violent only connoted a superficial semblance of agreement, and must therefore be deemed inaccurate.

§ 5.—*Tests of Accurate Conceptions.*

Even in the rigid analysis of phenomena with a view to the formation of distinct and adequate conceptions, we may fail to attain our object by relying too exclusively either upon sensation or the spontaneous processes of reason. In the latter case we must cross-examine our consciousness, view the objects which it presents us with in every light, connect them in gradual sequence with higher truths, test their accuracy by multiplied and diverging threads of argument, and, in all cases where such a procedure is possible, verify them by a direct appeal to facts. We must appeal, in the former, from sensation in its causes, set one sense against the other, and bring their testimony, in all cases where it is feasible, to the test of accurate measurements and quantitative laws. If we referred, like Lord Bacon[1], only to sensation as an indication of the presence of heat, we should be greatly deceived, since many of those things which excite in our organs, and especially of those of taste, a sensation of heat, owe this property to chemical stimulants, and not at all to their being hot. Again, there are a number of sensations, which, by a wise arrangement of Providence, are made to refer their seat of action from the mind to the parts of the body where they first occur, though the contrary is the fact. Thus, for instance, the painful sensation we experience in the hand or the foot, when fire or steel lacerates them, is nothing else than a feeling of aversion which the mind conceives at some movement in those parts, contrary to the natural constitution of the body. The con-

[1] Nov. Org. b. ii. table 2 (29, 30), &c.

ception of colour, as something inherent in an object, like its weight, hardness, &c., so that it would be impossible to see the object apart from its colour when nothing intervenes between the eyes, and it seems perfectly rational and obvious by the evidence of vision; yet we need only expose the object in a dark room to the different coloured prismatic rays, to invest it with any particular colour we please, and thus convict sight on its own evidence.

It was mainly to the want of a knowledge of experiment as an assistant to the analysis of natural phenomena that the ancients failed to obtain that command of clear and appropriate conceptions which have led to the formation of the physical sciences, and marked the successive stages of their growth. They failed to discover the laws of mechanics, because they had no clear ideas of pressure, resistance, momentum, and uniform and accelerating force; but the absence of such conceptions must be attributed to their slight of experiment, or their neglect to trace the principles of equilibrium and motion, by producing those phenomena under circumstances of sufficient variety to reveal their laws. In like manner the tardy development of optics, electricity, magnetism, mineralogy, and the higher generalisations of chemistry, may be ascribed to the absence of any conception of polarity, men contenting themselves with expressing wonder at what they deemed capricious freaks of Nature's workmanship, instead of ransacking her laboratory with a view to discover kindred phenomena, and to bind them up in one conception, which should connote their peculiar properties, and serve as a new kind of intellectual sense in leading to more wonderful discoveries.

It may, however, be observed, that it is not essential to the clearness of a conception that we should know all the properties of the things we class together. That would be, as Stuart Mill correctly observes, to have our conceptions of the class complete as well as clear. It is sufficient if we never use a conception without having ascertained what attributes it is intended to connote, and in virtue of what properties its component parts are bound together. For the rest, if we never strain a conception to mean more than our knowledge of the properties which it connotes implies, or introduce it into a sphere foreign to its application; if we

reject all those which are too vague and indefinite to admit of determinate extension and intension, and endeavour by a strict analysis, pursued in the spirit we have pointed out, to invest those which only are distinct enough to bear a logical determination with a distinct connotative character[1], our progress may be slow, but the ends of logic will be gained, in securing the preliminary operations of reasoning from error.

CHAPTER IV.

CONCEPTIONS IN RELATION TO SIGNS.

§ 1.—*Use of Language in Logic.*

THOUGH our ideas are mainly acquired though the medium of sensation and reflection, we should find ourselves at a loss to preserve the more general and complex ones in a permanent form, or to convey them to others, without assigning to each a peculiar mark or name by which it might be distinguished. With regard, indeed, to individual objects which have no connotative meaning, or those whose properties are bound up with sensible objects, and depend on no abstracting faculty for their formation, verbal signs would be hardly necessary to this end, inasmuch as the appearance of the objects themselves would awaken their respective ideas in the mind; yet even in these instances, which comprise a very small class of the conceptions employed in ordinary language, a sign is imperatively necessary to recal the idea, in the absence of its object to the mind of others, and to reason about it in conjunction with those of purely abstract formation in our own.

[1] The words in the text have reference to the double capacity of conceptions, which have been called by Sir W. Hamilton the cardinal point of logic. They may be expressed as follows:

A conception viewed as a

logical whole, has	metaphysical whole, has
extension,	intension or comprehension,
breadth,	depth,
sphere,	matter,
objects,	marks,
power to denote.	power to connote.

The importance of language, however, as an instrument of thought, rises in proportion to the degree of abstracting power with which each individual is invested; savage tribes and semi-civilised people requiring it very little, while nations of any pretension to refinement find its application on an extensive scale essential at every step, not only as a means of intellectual progress, but to maintain them in their actual position. Barbarous tribes, and even a large mass of the uneducated people of civilised communities, seldom lift themselves above individual objects, and in their inferences commonly creep along the ground of particulars. Hence, in their reasoning, nothing is required unless association to suggest ideas and sense to perceive their congruity or disagreement; a mode of inference of which brutes are capable, though in a less degree. But with men who deal in large generalisations, language is peremptorily required to fix the complex ideas to which their minds have attained in comparing classes of particular truths, and to enable them, by combining a wide range of properties in one expression, to start anew from groups of comprehensive details, as if they were so many particular facts, in order to reach still more extensive generalisations.

§ 2.—*Errors to which the Formation of General Terms are liable.*

But if language is thus essential to scientific reasoning, in clenching the results of the mind's abstracting power, it must be said to accomplish this at no ordinary sacrifice, since it introduces into the sphere of its operations all the confusion to which vulgar conceptions, the caprices of custom, and the revolutions of the outer world, give rise. Unless in matters of physical science, where the formation of general terms is exclusively in the hands of professional guides, such names generally owe their origin to the vulgar, who, struck with a confused feeling of resemblance between several objects, combine them in one expression, without exactly knowing the common properties which their appellation is designed to connote. Take the word civilised, for instance. Having observed that men who live in cities agree in the possession of certain marks of refinement which the denizens

of forests do not manifest, they call the former civilised, though without knowing exactly in what the essential meaning of the word consists, or the number of properties which is required to justify its application. Hence no two persons, even among the most educated, would be found to agree in determining the limits of this word, or its abstract civilisation, and when it is predicated of anything no other person knows, and even the speaker himself is ignorant of the precise objects he means to assert. Every person need only examine the vocabulary of general names he is in the habit of using, as beauty, greatness, honour, and gentleman, to discover a host of others which exemplify this uncertainty in a still more striking manner.

Even with names whose connotation is less exposed to cavil, being determined with precision by men of accurate habits of thought, or marked out by our common instincts, much confusion may originate by the fluctuations of belief and opinion, which fling the mind upon new modes of thought, and unfix its old creations. The word piety was doubtless applied by the ancients to denote that class of actions which took place in conformity with the moral law, and the prescribed usages of their religion. With Christians, a stigma would be fixed on the majority of cases to which they applied the name. The same term in the writings of a Pagan philosopher we could hardly take upon ourselves to determine until we knew the school to which he belonged; while the sense which the modern divine attaches to it agrees with none of those schools, and the meaning this word bore in the mouth of French society at the close of the eighteenth century conflicts with all.

When such names become connected with philosophical doctrines or habits of belief which men choose to uphold as the fundaments of truth or the arbiters of their destinies, the contests to which they either give rise or serve to aggravate are innumerable, and become too much interwoven with the feelings to be settled by the rules of the mere logician. What acrimonious disputes have arisen among modern polemics about the respective merits of *faith* and *works*, which, had they only reflected that the scholastic theology employed the former term only to express a simple act of belief, would never have taken place. Some controversialists, seeking to resolve such disputes by having recourse to the derivation of

the word, regard a bishop as a sort of moral inspector, because the original Greek word επισκολος signifies to overlook. They might as well call a policeman an apostle, because he is sent forth (αποστελλειν), or the church an assembly of democrats, because εκλησια was used by the Greeks to designate a popular meeting.

§ 3.—*Confusion arising from the Transitive Application of Words.*

It is one great law of association of ideas that leads mankind to fix the same term to a congeries of objects, some of which have nothing in common, though they may be connected by a confused feeling of resemblance in the intermediate links which led to the adoption of a common term. Thus, as Dugald Stewart observes, if we allow A, B, C, D, E, to denote a group of objects, in which A possesses some quality in common with B, and B a quality in common with C, and C with D, &c., while no quality can be found in common with any three objects in the series; the affinity between A and B may produce a transfer of the name of the first to the second; and that in consequence of the other affinities which connect the remaining objects together, the same name may pass in succession, though the intermediate links from A to E, and a common appellation be affixed to both of those objects, though they may widely differ in their nature and have not one property in common. When the association is slight and casual the several meanings will remain distinct from each other, and assume, in process of time, the appearance of capricious varieties in the use of the same arbitrary sign; but where the association is so natural as to become virtually indissoluble, these transitive meanings will coalesce in one complex conception, and every new transition will become a more comprehensive generalisation of the term in question[1].

This law, in its last result, has been the source of infinite confusion in reasoning, since it generally gave rise to the belief that the general name thus established connoted a common property among the objects it designated, and led grave philosophers into the chimerical search of finding it out. The endeavours of Plato to abstract the essential properties of the

[1] Philosophical Essays, 226, 27.

good, the *fit*, the *becoming*, from a crowd of dissimilar objects, though furnishing perfect examples of the preliminary process to induction, was really so much beating of the air, since the phenomena whose common properties he attempted to discover had really no common properties at all; and Aristotle's attempt to trace the common idea, which in the case of any effect belongs to the efficient, to the matter, to the form and to the end, with Bacon's inquisition into the nature of heat, must be placed in the same category. In each of these cases the above philosophers, led astray by the confused generalisations of the vulgar, which they unsuspectingly accepted as something real, wasted an infinity of sober calculation to reach a definition which should serve for several distinct meanings at once, and classify objects which had no property in common.

§ 4.—*Twofold Law of the Transformation of Names.*

But in a greater degree than mental law, custom is a great arbiter of language, and tends to confuse the ideas they denote, either by completely changing the signification of words, or widening and contracting their logical or metaphysical sphere. The first case may be exemplified in the word Pagan, originally equivalent to a villager[1], but which, from having been used in the fourth century of the Christian era to denote the country-people among whom the old mythology still lingered, came gradually to suggest the idea of a worshipper of the old divinities, until the additional peculiarity of their residence being also wiped out, the term suggested nothing else. In the same manner villain, which in the middle ages signified a serf of the soil, came to imply, after serfdom had been abolished, all the hateful qualities of crime and guilt by which many of that class had been distinguished.

These cases, however, are extreme instances of a movement of generalisation continually going on in language, and are not likely, when the new meaning is completely evolved, to generate confusion; it is only in the transition state, when two or three distinct conceptions are floating about a name, or when words are extended to fresh classes of objects

[1] From the word *pagus*, a village.

without sufficient discrimination between the old connotation and the new cases to which they begin to apply, that any error is to be dreaded. The phrase *landed proprietor*, for instance, with the first English conquerors of our East Indian settlement, would have led to no error had it recast its connotation at the same time that it extended its sphere. It was the application of the term in its old signification to fresh cases, which the framers of that signification had never contemplated, that led the conquerors of Bengal, by confounding limited with absolute rights, to drive whole classes of men to ruin and despair, to fill the country with banditti, and to produce, with the very best intentions, the disorganisation of the country.

A counter movement to the generalisation which custom produces in language, may be witnessed in such terms as *loyalty*, when the original meaning becomes specialised. That word was accustomed to signify fair, open dealing, as it indeed still means in French, whence it was imported; whereas it is now restricted to the single case of fidelity to the throne. This tendency to use general words in a restricted sense is much increased as civilisation advances, owing principally to the growing habit the refined manifest to keep the disagreeable aspect of things as much out of sight as possible, and to speak of objects which give rise to any unseemly ideas, so as to convey the faintest suggestion of their characteristic qualities. The effect, however, of this law is not so much to unfit a language for the purposes of accurate discrimination, as to render its general terms unsteady exponents of their old meanings, and to leave the particular ones whose places they have invaded to fall into desuetude and decay.

§ 5.—*Logical Definition.*

To remedy the errors to which the mind is exposed from the fluctuations of language, as also more distinctly to realise and determine the nature of its conceptions, recourse is had to definition—that is, a mode of laying down their exact boundaries, and marking each by so essential a feature of its nature as shall imply all the properties it connotes. The logical rule for this purpose is to express the object whose

definition is sought in terms of its proximate genus and difference. Every conception capable of entering the mind Aristotle[1], as we have seen, ranged under the head of one of his ten categories, and when he wished to hunt out, as he called it, the essential nature, or, according to Albertus Magnus, the *quiditas* of a thing, the enunciation of whose nature constituted its definition, he divided the head of the category in which it was included into its subaltern genera until he reached the one under which the object before him was contained, and this last genus, along with the specific difference by which it was divided, constituted its logical definition. Thus the definition of triangle is obtained by the subdivision of quality into its four kinds, including figure, and figure into its various kinds, including plane rectilineal, the last of which is the proximate genus, as the triangle constitutes one of its species, with the distinguishing difference of three sides. We need not, however, follow so circuitous a route, as a very slight knowledge of the subject, with moderate habits of generalisation, will be sufficient to suggest the proximate genus without the intervention of a category.

It happens, in the majority of cases, that the distinguishing difference may be selected from a variety of properties, each equally essential to a proper conception of the object; as in the triangle, the attribute of its three angles being equal to two right angles is of no less importance than its possession of three sides; yet there is one of these properties generally which strikes us as more prominent than the rest, or which is more important in reference to the end we have in view, and this, consequently, ought to constitute the differentia in our definition. It is always essential, however, to the greater accuracy of our conception that we steadily keep the distinction between property and differentia in view, and do not employ an attribute which is virtually implied—*i. e.* easily deducible from others of superior importance. That property ought to be selected as the differentia out of which all the others can be the most easily evolved. Another caution to be observed is that the genus do not enter into—*i. e.* constitute a part of the

[1] Anal. Post. ch. 13. Pacian's division.

difference[1]. In some cases, however, this blending is unavoidable; as in the definition of curved and right lines, the idea of rectitude and crookedness which form their specific difference cannot be viewed apart from length, which constitutes their genus.

The great end of logical definition appears to be to unfold the nature of a thing in as few words as possible, that the notion may be clearly seized by the mind, and no entrance given to words which admit of doubt or cavil. If properties which are virtually implied in the specific difference were expressly associated with it in the definition, it is clear this object would not be gained, the mind being liable to view the two properties as separable[2]. Thus, to define a parallelogram, as a four-sided figure whose opposite sides are parallel and equal, might lead the mind to suppose that there may be a four-sided figure whose opposite sides are parallel, but not equal. For the mention of any circumstance introduced into the statement of a definition or of a precept, is to be presumed so necessary to be inserted that the definition or precept would not attach if this were absent. If we were told that some celestial phenomena could not be seen by the naked eye, it would be inferred that it might be visible through a telescope, just as it has been concluded from St. Paul's injunction, "Let a bishop be a man of one wife," that the laity might have two.

The proximate genus is laid down as an essential part of this kind of definition, since, if a genus more remote was taken, the definition would be too extensive—*i. e.* include more than its object. Thus, to define fish as an animal which lives in water, would include under that name all the insects who live in the same element. In like manner, the definition would be inadequate, if an accidental property was taken for the specific difference. For instance, if we were to define fish as an animal which has an air-bladder, the definition would be too narrow, since there are many fish without any.

[1] Galluppi's Lezioni di Logica, § 22, p. 168.

[2] Wolf has very properly said, "In definitione enumerare debent notæ nec plures, nec pauciores quam quæ ad rem definitem agnoscendam et ab aliis distinguendam sufficiunt." § 15.

It is clear that individual terms are not capable of strict logical definition, though they may be distinguished with sufficient accuracy from others by an analogous process. Thus to describe a rosadendron, we take the peculiar properties of its petals as its specific difference, while we assume the species flower as its genus. There are also a large class of simple terms, merely used in a denotative character: to define these in terms clearer than their own would be impossible, and hence they are accepted by all as perfect exponents of their own meaning[1]. This is according to the nature of the case; for if we attempted to define every word, it is clear that, in many instances, the thing defined must enter into the definition, since it would be impossible to commence the task without assuming some words in our first definitions as already sufficiently clear; nor could we close it without defining the words so assumed in terms of the definitions which they had contributed to establish. In every instance, however, in which this occurred, our definition would be a nullity. To say a circle is a circular figure, is really to say nothing. Hence Locke cautions us against using words in our definitions which are synonymous with the thing defined[2]. Wolf calls this the vicious circle of definitions, and cites as an instance of it the definition of a day as a part of time made up of twenty-four hours.

§ 6.—*Definition how far Real.*

If we consider with Locke[3] the real essence of a thing that by which it is constituted what it is; or that one quality—if there be such—upon which all its other qualities depend, it is evident no definition that we can frame of anything existing external to us can be accepted as unfolding the real essence of its subject, but only what is commonly termed the nominal essence, viz., that by which the mind conceives it to be what it is. But as the ideal nature of a thing is identical with its real nature in all conceptions

[1] Descartes' Principes de Philos. 4, x. Wolf, however, together with Baumerster, attempted to define *existence*, but only succeeded in darkening the meaning of the word. [2] B. 3, c. 4, § 6. [3] B. 3, c. 3, § 15. Yet in b. 3, c. v. he restricts his meaning to the essence of simple ideas and those of substances, and allowed the names of mixed modes and artificial things to signify the real essences of their species.

which are purely of the mind's creation; to define these in terms of their real essence, we need only assign to them those attributes which led the mind to erect them into distinct conceptions. In mathematics for instance, every definition will imply all the properties that belong to the thing defined, since they entered into the mind's conception of it; and in morals, where any partial ideas are bound up into a complex one, as in parricide, incest, sacrilege, &c., the mind will at once recal the ideal attributes which led to its formation as constituting its real definition, little solicitous whether such entities have existed or are ever destined to exist in nature.

It is very important, however, to observe, that this question cannot be so summarily disposed of as Locke imagined, since that can hardly be called an ideal definition which has its roots in the nature of objective realities, and is determined by their complexion. If it does not unfold the entire nature of the thing, or in other words, leaves out even of its implied statement many properties which are involved in its existence, it at all events suggests a portion of such nature, and, *pro tanto*, is real. The condition that the definition express that quality of the object on which all its other properties depend in order to be real, is wholly hypothetical, since no person can undertake to say whether such property exist: and to postulate an imaginary essence as essential to unfolding the real nature of a thing, is very much like proving what is by something which is not. In many cases the absence of such all-embracing quality can be fully shown without affecting the real nature of the definition, as in those instances which refer to the actions of things rather than to their constitutive properties. For example, when examining the nature of motions produced by gravity it was found that their uniformity was the result of the ratio of the velocity to the time elapsed, these co-ordinate attributes were allowed to constitute the real definition of uniform motion, though they fail to express its entire nature, and lead to no derivative properties.

§ 7.—*Scientific Definition.*

Clear definitions of the last kind are of immense scientific importance, inasmuch as the quick progress of physical knowledge in modern times may be ascribed to the results to

which they have conducted, and is involved in the process of their formation. Hence, the establishment of scientific definition is the reverse of that laid down by Aristotle, beginning with the most scrupulous examination of the elements of the objects to be defined, and endeavouring to arrive at their exact nature by subjecting it to every combination that experiment can devise. The phenomena, among which the elements of the object is to be sought, will of course be pointed out by the nature of the question involved, as Aristotle's genus and differentia were hunted out from their corresponding category; but these elements, depending on the laws of physical substances, can only be selected through the medium of observation and comparison. For example, the inquiry concerning the law of falling bodies led to the question, whether the proper definition of a uniform force is proportional to the space from rest, or to the time. Taking it for granted, what indeed had been fully proved, that gravity was a uniform force, the results of observation collected from a series of experiments, being subjected to the test of calculation, showed that the ratio of the velocity was to the time elapsed. In like manner, when it was observed, in the case of two bodies infringing upon each other, that the momentum lost by the one is equal to that gained by the other, the question naturally arose what is that of which a body when it sets another body in motion loses exactly as much as it communicates? And when experiment had shown that this something was the product of the velocity of the body by its mass, or its quantity of matter, this became the definition of momentum.

The establishment of scientific definition, therefore, is part of the business of discovery, and requires for its accomplishment no small portion of that sagacity by which truth is detected; whereas logical definition in all cases, where it is not hypothetical, has really no other aim than to demonstrate truth when discovered, in placing the essential nature of one of the terms out of which it is to be evolved clearly before the eye. In moral speculations, indeed, when we arrive at truths unknown before, by grave deduction from principles independent of experience, it is quite possible, and in most cases expedient, to establish our definitions according to the Aristotelian rule; but where the laws of physical nature are

concerned, it is clearly absurd to attempt to frame our ideas of the objects they involve by any other method than that of registering their principal properties as observation and comparison point them out. In this way many of our definitions will be necessarily progressive and provisional; extending their connotation as the progress of discovery throws additional light upon the intrinsic nature of the object they design to unfold; they will nevertheless be clear and explicit in drawing a boundary between the light and dark side of a subject, and excite inquiry by placing the mind directly in front of the unknown[1].

§ 8.—*Nominal Definition.*

Up to this point, all our remarks refer to those definitions which concern things. There are, however, a different class, which arise from giving a settled meaning to names otherwise vague and uncertain in their connotation, with a view to exclude any ambiguity from phrases in which they may happen to be employed. Such definitions are called nominal, or definitions of names[2]. For instance, the word spirit occurs in dispute, and introduces the usual half-a-dozen meanings that commonly cluster round it. We ought in that case, with a view to avoid anything like equivocation, to restrict the word to some one of these significations, or if none of the attributes formerly assigned to it convey our sense, to invest it with a new signification.

[1] Aristotle being entirely unacquainted with the modern method of discovery, had no distinct conception of the kind of definition it employed. Whenever he departs from his own method, it is only to entangle himself in vague metaphysical distinctions and imaginary assumptions; as an instance of which, we may take his definition of motion—the act of a being in power, inasmuch as it is in power; and of light—the act or energy of a transparent body, inasmuch as it is transparent. In these cases, he first assumed the motion of body or being, then that of act and potentiality, and refused to consider nature unless under these two arbitrary assumptions.

[2] Archbishop Whately seems to confound them with the etymological explanation of a word which may be found in a dictionary.—*Logic*, b. ii. c. v. § 6. But there is a wide difference between nominal definitions and the meaning arising from the conventionalities of a language. In the first case we define a word arbitrarily, in order that our conceptions may be clearly communicated to others; in the latter we adhere to that signification which is attached to it by the common usage of society.

The meaning thence arising in either of these cases would constitute the nominal definition of spirit.

Such definitions are clearly distinguishable in many respects from the definitions of things, though each come under the common classification, and are subject to the same rules and exposition. For a word being a sound to which we may attach any signification we please, provided we apprise others of our intention, a nominal definition cannot be contested, but must be taken as a principle; but definitions of things may be contested by those who deem them false, and cannot be assumed as principles until they are fully demonstrated—unless, indeed, they are evident of themselves as axioms. We are not, however, to infer anything more from a nominal definition than the idea which we have attached to the name; or believe that, because we have given the name a definite meaning, that it must signify something real. For example, if any one call heaviness the inward principle which makes a stone fall without being impelled by anything, though we cannot contest the definition, since it merely enables us to understand what he wishes to say, we ought not to admit that to be anything real which he means by the word heaviness, because there is no such principle in stones.

As a further instance of nominal definition, may be adduced the apparent discrepancy between the meaning of the term idea as taken in the Peripatetic, Cartesian, and Lockian schools. The first maintained that all ideas were false; the second that all ideas were true; and the third, that ideas were neither true or false. Which opinions, though their apparent antagonism is apt to set precipitate people by the ears, are really all correct, since the relation of ideas to outward realities are assumed by each in opposite senses. For Aristotle, taking the word idea as synonymous with the sensible image which the exterior object, through the medium of the senses, conveys to the mind, maintained that such idea was false because it did not represent the object as it really existed in nature. Thus the visual impression we receive of the stars is that of "small patens of bright gold," and not suns or worlds, as science demonstrates them to be. But Descartes applied the term ideas to the reflection of the sensible image in the mind; and, consequently, asserted their truth,

on the ground that they correctly represented things as they appeared to us—a doctrine of course which no peripatetic could dispute. While Locke, using the term idea to denote the mere presence of an object in the mind, asserted it could not be either true or false until we expressed some judgment concerning it; and then the truth or falsity would not enter into the idea, but into the nature of the inference of which we had made it the subject—an opinion which we opine neither Aristotle or Descartes would be inclined to quarrel with.

The neglect of nominal definition, when names are liable to be taken in a variety of senses, occasions interminable disputes, and leads men, by confounding what is clear and true in confused ideas with what is false and obscure, into very deceptive errors. Thus philosophers formerly associating the word fire with heat, and stone with heaviness, believed that nothing could be clearer than that the former was hot and the latter heavy, without in the least imagining that these two judgments might be false in one sense and true in another. If they signified by heat simply that which really produces the sensation of heat in us, and by heavy that which falls to the ground when nothing upholds it, the assertion evidently would be accurate; but if they understood by heat that which is the cause of that sensation, whatever it be, within us, and by weight that which has in itself a principle which makes it fall towards the centre of the earth without being impelled by anything, it is evident that neither proposition would agree with facts.

It is also a very common practice, and perhaps by none more assiduously followed than by Aristotle and the scholastics, to confound the definition of things with the definition of names, and to invest the former with that uncontested character which can only belong to the latter. For example, when the peripatetics defined that quality in a concave mirror which burns wood, when applied to the sunbeam, to be an ustorious principle arising from its substantial form; and insisted upon the acceptance of this definition as a satisfactory explanation of the phenomenon in question; or when they referred the hardness, colour, heat, and other properties of bodies to certain occult qualities, in virtue of which they are as they are, and beyond which it is useless to

inquire further, they palmed bad nominal definitions, conveying no meaning of a positive character, upon their age as correct exponents of natural facts; and succeeded, ridiculous as it may appear, in passing on these deceptions through numerous generations, by assuming the tone of men who had nothing to learn, and pretending to treat those who denied such principles as men who were not worth disputing with[1].

BOOK II.

PROPOSITIONS.—PROEMIUM.

CONCEPTIONS of themselves imply nothing, beyond the fact of consciousness. It is only by comparing them together, with a view to their mutual agreement or exclusion, that we obtain knowledge; and the sentence by which this act of the mind is enounced, is called a proposition. Hence a proposition may be defined to be an indicative sentence, that is, a sentence affirming or denying, the adjective being accessory, as differentia, to exclude questions and commands, which are also sentences, but unaccompanied by any act of judgment. In whatever order the two terms which constitute the matter of a proposition stand, that which we affirm is called the attribute or predicate, and that of which we affirm, the subject[2]. The verb which connects them is called the copula.

It is hardly for us to inquire into the nature of the

[1] Definitions are commonly divided by logicians into other classes, such as accidental, which denotes one in which the differentia is an accident, not an essential property of the subject, as a man is an animal who sows wheat and plants vines: and physical, in which the object is simply divided into its natural parts — as, Britons are those who dwell in England, Scotland, or Wales. But we need not trouble the student with a host of distinctions, which owe their rise to scholastic trifling.

[2] If the student will remember that what we affirm is the attribute of every proposition, and that of which we affirm, the subject, he can never be at a loss to distinguish these two terms in any proposition, no matter however complex, or in whatever order its members may be found. For example, in the proposition, "It is disgraceful to obey one's passions;" it is clear from the sense that to obey one's passions is the subject, since we affirm of it the term disgraceful. Of a similar kind are such propositions: It is foolish to listen to flatterers. It is hail which falls. Propositions, however, may be blended with

mental phenomena which constitute judgment; whether it consists, as the conceptualists say, in the expression of a relation between two ideas, or according to the doctrine of the nominalists, in the simple expression of agreement or disagreement between names. Such a discussion is rather of metaphysical than logical concernment. Though it is essential, as the principal at stake deeply concerns the theory of reasoning, that the logician should have made up his mind on the subject, and shape his views of the science in accordance with the conclusions to which he has arrived, that the structure may arise in harmonious consistency with its metaphysical foundations.

According to the opinions to which such speculations lead, propositions are denominated real and verbal, identical, or essential and accidental, as the different relations in which their terms stand to each other and to their subject-matter determine. If the predicate assign to the subject a determinate attribute whose agreement has been ascertained from experience, or withhold such attribute on the same evidence, as: man is mortal; a charlatan is not worthy of esteem—all would concur in denominating such propositions real,

matter extraneous to the mere attribution or denial of a quality with respect to the subject, as in the instance of active verbs, accompanied with two or more cases. Thus: God commands us to honour our parents. The law bids us to respect the queen: where, without changing the active verb into its passive, we may find it difficult to distinguish either subject or attribute. As soon as this is done, however, the terms of both propositions, by the application of the test, become easily apparent, as: Our parents are to be honoured (by the command of God). The queen is to be respected (according to the injunction of the law).

It occasionally happens that the attribute is one simple word, while the subject is composed of many propositions, as in the stanza of Horace:

> Beatus ille, qui procul negotiis,
> Ut prisca gens mortalium;
> Paterna rura bobus exercet suis,
> Solutus omni fænore;

where beatus is the attribute, and all the rest the subject. We also sometimes meet with sentences in which the determination of the predicate will depend upon the emphasis which the speaker chooses to lay upon a particular word. Thus: The Organon of Bacon was not intended to supersede the Organon of Aristotle, where at least six of the principal words may separately be taken as the predicate, according as the stress is laid upon each in the enunciation of the proposition.

though some might deny their existence[1]; but should the terms simply relate to the meaning and extent of the words employed, and not to the things signified by them, as: *proper names are not connotative*, the resulting proposition is verbal. In like manner, propositions may be called accidental, essential, or identical, according as the property represented by the attribute is merely an accessory of, or inherent in, or equivalent to, the subject[2].

Regarding the two terms of a proposition as expressive of its matter, and the act by which they are confirmed or separated as relating to its form, all that the logician has to advance upon this portion of the science may be treated under these two heads. The material aspect of propositions subdivides itself into simple and compound; the former section branching out into complex and incomplex, the latter into expressed and tacit propositions. Simple complex propositions may be subdivided into determinative and explicative;

[1] As Hobbes, and the extreme section of the nominalists. [2] Mill gives a different account. According to his theory of reasoning, when we attribute to a subject any property which attaches to it as a class, we form an identical judgment; or, in other words, we simply affirm what is—as, man is an animal; a tree is a substance; since all the properties which constitute the class make up our idea of each individual included, and to predicate the one of the other is simply tautological. To such propositions he applies the three names, essential, identical, and verbal, denominating those accidental and real which register the results of our experience. We, however, cannot see any ground for the distinction taken between the attribution of properties which constitute a class, to one of the individuals included under it, and of those derived from experience, to a subject with whose nature they have never been associated. For how are classes formed—even according to Mr. Mill's own showing—if the first category of properties do not grow out of the second? But surely there is nothing beyond a distinction of time between the attribution of a property to an object that has been discovered by induction, and that of a property which has already entered into our conception of it through the habit of association. Both marks may be equally essential to its constitution, though the former may be less prominent, and require something more than a superficial glance to distinguish it. The name identical, which Mr. Mill gives to what he calls verbal definition, appears equally unfortunate. When a horse is said to be an organised being, endued with sensation, we do no infer that the predicate is coextensive with the subject, which, however, is the mark of identity in a proposition. Locke more correctly affirms, that all identical propositions are tautologous, and cites as examples those in which the subject and predicate are exactly equivalent to each other.—Hum. Under. iv. viii. 4.

expressed compounds into copulative, disjunctive, conditional, and causal; and tacit compounds into exclusive, exceptional, and comparative. The relation of these sections will be sufficiently clear from the following scheme:

Propositions with regard to their matter.

- Simple and compound
  - Simple
    - Complex, incomplex
      - Determinative, explicative.
  - compound
    - Expressed
      - Copulative, disjunctive, conditional, and causal.
    - Tacit
      - Exclusive, exceptional, and comparative.

As regards their form, propositions are usually divided into affirmative and negative, and these, accompanied with two other properties of propositions, give rise to the process of opposition and conversion, which, as they mainly depend upon the form, may be treated under that head[1].

[1] Kant's division of propositions is according to the four necessary forms with which a judgment must be invested, viz., quantity, quality, relation, and modality. With a little alteration, the scheme in the text might be blended with it, which would enable the student to recal at a glance everything important to recollect in connexion with this branch of logic. Thus—

- Propositions
  - with regard to relation
    - simple
      - complex
        - determinative
        - explicative
      - incomplex
    - compound
      - expressed
        - categorical
        - disjunctive
        - conditional
      - tacit
        - exclusive
        - exceptional
        - comparative
  - with regard to modality
    - probable
    - contingent
    - necessary
  - with regard to quantity
    - universal
    - particular
    - singular
  - with regard to quality
    - affirmative
    - negative
    - limited
  - (quantity and quality:) opposition and conversion

CHAPTER I.

PROPOSITIONS WITH REGARD TO MATTER.

§ 1.—*Simple Complex and Incomplex Propositions.*

When a proposition has only one subject and one attribute, it is called simple—as, Mirandola was a platonist; should either or both of these terms comprise more than one subject, or predicate, it is denominated compound—as, Plato and Pericles were cotemporaries; or, Sir Thomas More was both a judge and philosopher; Charlemagne and Alcuin founded schools and erected churches. There are, however, many propositions which embrace in reality only one subject and attribute, but which nevertheless appear compound, on account of certain incidental propositions being connected with one or both of the terms by *who* or *which*, whose function is in these cases to constitute one proposition out of many. Thus: Alexander, who was the most generous of kings, conquered Darius; or, expressing the incidental proposition, as a Latin substantive in apposition—Alexander, the most generous of kings, conquered Darius; or, Boethius, the most learned man of his time, translated Aristotle. Such propositions are termed simple complex, for though the attribute, or subject, may embrace several propositions, they do not on that account lose their unity. By destroying that unity, however, they become compound propositions: as, Alexander was the most generous of kings, and the conqueror of Darius; Boethius was the most learned man of his time, and the translator of Aristotle.

The complexity of a proposition may fall on the subject, on the attribute, or on both. Thus: Every man who fears nothing is a king—is an example of the first: Piety is a good which renders man happy in the greatest adversity—is a case of the second: and—The great who oppress the poor will be punished by Providence, who is the protector of the oppressed—is an instance of the third. As it is a peculiarity of such propositions that they may be contradicted in two ways, viz., either by denying the attribute or the incidental proposition of the subject, it follows that all proposi-

tions compounded of active verbs and their objects must be reckoned complex, since they admit of double contradiction, and thus imply two propositions. For example, the statement —Brutus killed a tyrant: may be expressed, Brutus killed one who was a tyrant, and may be consequently contradicted either by denying that Brutus killed any one, or that the person whom he killed was a tyrant.

§ 2.—*Simple Complex Propositions.*

Incidental propositions may be annexed to a subject, either with a view to unfold some of its essential properties, or to restrict its signification. In the former case they are denominated explicative, in the latter determinative. Thus: "Men who are endowed with reason are responsible beings," is a proposition in which the incidental term is explicative, the feature of rationality being an essential part of man; the attribute consequently may be considered, apart from the incidental proposition, as solely referable to the subject, as, "men are responsible beings." But when the incidental proposition simply restricts the meaning of the subject, in annexing to it a property which is not coextensive with it, as—Men who are pious are charitable, such incidental proposition is called determinative, and the attribute can no longer be considered as affirmed of the subject alone, but must be applied to it as restricted by the incidental proposition. For it would be evidently wrong to say, "men are charitable," since we know that a great many of them are malevolent. Hence incidental propositions which are explicative are readily distinguished from such as are denominative, by omitting the part qualifying the subject. In which case, the explicative proposition will lose nothing of its truth; while the determinative will imply an absurdity.

Error is only liable to steal into incidental explicative propositions, since they alone affirm an attribute of the subject to which the relative pronoun appertains. For example: the proposition, "Horace Walpole, who was the son of the Earl of Orford," affirms, though incidentally, that Horace was the son of that nobleman, and consequently, if it be not so, as some suspect, it states a falsehood. Should error, however, lurk in the incidental proposition, it cannot affect the truth of the principle. Thus: "Horace

Walpole, who was the son of the Earl of Orford, wrote the most delightful letters in the English language," would not be considered the less true if Horace was the son of another man. Incidental determinative propositions cannot be false, since they are simply applied to restrict the signification of the object without affirming or denying anything concerning it, beyond the mere assumption of their possibility. For example: when we say, "senators who never say or do anything by favour or party feeling," we do not say that there are senators who so comport themselves, though we virtually imply the possibility of their existence; and so far such propositions may be false.

§ 3.—*Compound Expressed Propositions.*

We have seen that compound propositions are distinguished from simple by the plurality of one or both of their terms. Now, according as the composition is denoted verbally or implied, these may be denominated, expressed or tacit. The prior member of the division embraces copulative, causal, disjunctive, and conditional compounds. Of these, copulative and causal may be united under the head of categorical.

As all propositions are termed categorical which affirm or deny anything directly of another, every simple proposition may rank under that head; but the term is taken here to distinguish that class of compounds connected by the copulative conjunctions *and* and *because* from those which are hypothetical and disjunctive, with a view to trace their peculiar laws, and define the respective relations of each of these classes to one another[1].

Copulative compounds may comprise a plurality of sub-

[1] Dr. Whately takes categorical as opposed to compound, which he calls identical with hypothetical syllogisms, including under the latter term, conditional and disjunctive syllogisms (*Logic*, b. ii. c. iv. § 2). But this is surely wrong; for compound propositions, besides all simple propositions, include many which are categorical, while the term hypothetical is synonymous with conditional, and to substitute it for compound is to confound a genus with its species. Boethius, the first among the Latins who elaborated this part of logic, employs indifferently the terms *hypotheticus conditionalis non simplex* for the genus, as opposed to *categoricus*. See *Edinburgh Review*, April, 1833. The division of categorical into pure and modal (*Logic*, b. ii. c. ii. § 1), in which the archbishop, as usual, follows Aldrich, is equally unfortu-

jects, of attributes, or of both, and accordingly give rise to three corresponding kinds of propositions. Thus, the proposition, death and life are in the power of the tongue, contains a plurality of subjects; while the dicta of Horace, that "a well-regulated mind hopes for prosperity in adversity, and fears adversity in prosperity[1]," and "neither houses, nor lands, nor heaps of gold and silver, can chase away fevers from the body, or cares from the minds of their possessors[2]," comprise a plurality of attributes and a plurality of subjects and attributes respectively. The truth of these propositions depends on the truth of each of their parts; the falsity of any one of which invalidates the whole.

Copulative propositions are only considered negative when the negation falls on the conjunction, which may, however, happen in various ways, sometimes at the head of a sentence, as, "we cannot be in love and be wise[3];" occasionally in the centre, "as love and majesty do not agree together[4]".

Causal propositions are those which express the cause and effect of a thing together. For example: a stone unsustained falls, because it is heavy:—such a prince was unfortunate because he was born under a certain constellation. To be true, such propositions require the proof of three things, viz., the reality of the existence of both cause and effect disjointly, and then the establishment of the fact that the effect really follows from the cause which has been assigned to it. The neglect of the former of these conditions gave rise to the absurd attempt of the Royal Society to solve the celebrated problem of Charles II.—Why does a fish lose its weight by being immersed in water? Had the members set out with ascertaining the reality of the

nate, since it leads the student to infer that there are pure propositions which are not modal, and restricts the term modality to a meaning which in its strict sense that word does not bear.

[1] Sperat infestis, metuit secundis
Alteram sortem, bene præparatum
Pectus.—*Hor. Car.* ii. 10.

[2] Non domus et fundus, non æris acervus et auri,
Ægroto domini deduxit corpore febres
Non animo curas.—*Hor. Epist.* i. 2.

[3] Amare et sapere vix deis conceditur.—P. Syrus, Sent. 20.

[4] Non bene conveniunt, nec in una sede morantur
Majestas et amor.—*Ovid, Metam.* ii. 846.

fact which his majesty called upon them to solve, they might have escaped from the absurdity of applying their grave powers to account for a nonentity. The falsity of a causal proposition may be shown by impugning either the reality of the effect, or its sequence from the cause. Thus, the statement that the change in the general climate of the globe is owing to the earth having cooled from a state of absolute fusion, may be contradicted, by proving that such absolute fusion could never have occurred, or was insufficient to account for the phenomena in question. If the existence of the subject only be disproved, the proposition is simply put out of court as an assertion about nothing.

Disjunctive propositions consist of two or more simple propositions, into which the disjunctive conjunctions *either*, *neither*, and their correlatives enter, and the force of which is to state an alternative. For example: "A man is either a fool or physician at forty;"—"women either love or hate, they are never indifferent[1];"—every deliberate action is either good or evil. The truth of these propositions depends upon the necessary opposition of the parts which ought to exhaust the subject and admit of no medium. But as such absolute exhaustion is not attainable in all subjects, those disjunctives may be considered morally true which approximate to it. For instance, though the proposition, men act either from interest or fear, is not absolutely true, since there are some who act from neither of these passions, but from a consideration of their duty; yet it may be accepted as morally certain, because it embraces the two motives which influence the majority of mankind. The proposition, however, that every man who disobeys the law, is either ignorant of its existence or misconceives its import, is neither morally nor absolutely true, since the greater portion of defaulters infringe it through defect of will. Though the truth of one and only one of the members is generally implied in these propositions, and the division is consequently reckoned exclusive, this, as in the instance of the proposition just cited, is by no means universally the case. For all men are generally impelled by interest, fear, and duty, at some time or other in their lives, and occasionally are influenced by the three motives conjointly; so that from the affirmation of one, we

[1] Aut amat aut odit, mulier; nihil est tertium. P. Syrus, Sent. 26.

are not led, as in alternatives properly exclusive, to reject the other.

Conditional propositions are those which assert the necessary dependence of one proposition on another; for example: if the soul is spiritual it is indivisible. The clause which conveys the condition is called the antecedent, the other the consequent. These propositions may be true with regard to the necessary connexion of their parts, but false with regard to their matter. As: if the will of the creature is capable of frustrating the absolute will of God, God is not almighty. If the earth was not made by a wise artificer, it was either produced by a fortuitous concourse of atoms, or must have existed from eternity. Hence, in relation to the truth of this class of propositions, we need only examine the connexion, since if that be true, the sentence, so far as it is conditional, holds good. Though in every instance, where the dependence is established, the consequent follows from the admission of the antecedent, the antecedent could not be inferred from the truth of the consequent. Thus, though we may say: If he be a man he is a two-footed animal, we cannot infer from his being a two-footed animal that he is a man. For the same consequent may follow from other antecedents.

§ 4.—*Reduction of Disjunctive and Conditional Propositions to Categorical.*

Though the validity of these kinds of compounds can be sufficiently tested by the rules already given, it is sometimes necessary, to avoid all ambiguity in the higher processes of inference, to reduce them to the simpler form of categorical propositions. For this purpose we must consider every conditional proposition as a simple affirmative with the antecedent for its subject, and the consequent for its predicate; for example, "if its inhabitants are industrious a country is likely to prosper," is equivalent to saying that the case of its inhabitants being industrious is a case of a country being likely to prosper. No hypothetical proposition is valid which cannot be reduced to such a form.

This law of reduction springs from the identity of the logical function of categorical and conditional propositions,

which simply consists in affirming the invariable connexion between their two terms, the only difference being that in categoricals the terms which are generally simple declare that a thing or class of things has some property, while in conditionals, the terms which always consist of propositions affirm either the causal coincidence of two facts or the dependence of two truths. When it is affirmed that all the tissues of the body continually decay and are reproduced, it is signified that wherever one of the tissues of the human body exist, decay and reproduction are going on; and in like manner, when we assert, if the moon comes between the sun and the earth, the sun will be eclipsed, we mean that when the moon is found in that position a solar eclipse will accompany it. In both instances one thing is affirmed to be a concomitant of the other. In the categorical a thing has the mark expressed by the predicate, while in the conditional a fact has another fact for its mark. The formula therefore represented by *the case, fact, or notion of this existing is a case, fact, or notion, of that existing* is sufficient for the reduction of any conditional to a categorical proposition[1].

Disjunctive propositions may be reduced to conditionals by assuming as an antecedent, the contradictory of one or more of its members, "thus either the earth is eternal, or the work of chance, or the work of an intelligent being," is equivalent to "if the earth be not eternal it is either the work of chance or the work of an intelligent being," the proposition in that case will nevertheless remain partly disjunctive. It may, however, be divested of its hybrid character, and transformed into a compound categorical by adhering to the formula above laid down. For example: "The possible cases in this matter are that the earth is eternal, that it is the work of chance, and that it is the work of an intelligent being." And again, either Horace Walpole is right in his historic doubts, or Richard III. was a monster; which proposition, categorically expressed, is, "the possible cases in this matter is that Horace Walpole is right in denying the existence of Richard III., and that of the monarch being a monster."

[1] Thompson's Laws of Thought, p. 169, 2nd ed.

§ 5.—*Tacit, or Implied Compound Propositions.*

These may be discussed under the head of exclusives, exceptionals, and comparatives. Those are termed exclusives which indicate that the attribute agrees with one subject, and that it agrees with nothing else. They consequently contain two judgments, and are for that reason called compound. For example, the conclusion of one of Martial's epigrams: "The only riches which will always remain with you are those which you have freely given away[1];" and the apothegm, "virtue is the only true nobility[2]." The truth of these propositions depends upon the agreement of the attribute with the subject, and with nothing else. Hence they can be contradicted in three ways, viz., either by denying the agreement of the attribute with the subject, or by affirming that it agrees with something else, or by pursuing both of these courses. For instance, against the expression of Martial, it may be urged, that riches which we give away do not remain with us: that the riches which we keep remain with us as well as those which we give away: that the riches which we keep remain with us, and not those which we give away. In like manner the celebrated maxim of the academics, "that it is certain that there is nothing certain," which affords another instance of an exclusive proposition, was differently contradicted according to the opinions of the sects who opposed it. For the Dogmatists maintained that it was doubly false, since in the first place if it could be affirmed that nothing was certain, at least the act of the mind by which that judgment was pronounced was certain; and in the second place they maintained that many other things could be known with the utmost certainty. The Pyrrhonists said the proposition was false for a contrary reason, viz., that everything was so uncertain that it was even doubtful whether there was nothing certain[3].

Exceptives are only another kind of exclusives, in which, instead of affirming the attribute of the subject alone, we deny

[1] Quas dederis solas semper habebis opes. Ep. B. v. Ep. 43.
[2] Nobilitas sola est atque unica virtus. Juvenal, Sat. viii. 20.
[3] Or according to the inimitable author of "Don Juan,"
"Who doubt that even doubt itself is doubting."

it of everything else, and express the subject as an exceptional case. Thus: "The Platonists alone, of the ancient philosophers, recognised the spirituality of God," becomes exceptive when we affirm that "none of the ancient philosophers except the Platonists recognised the spirituality of God[1]." This proposition evidently involves two judgments: first, that the ancient philosophers believed God corporeal; and the second, that the Platonists believed the contrary. Many of the terse sayings of P. Syrus and Seneca are of this character. As: "The miser does no good except by dying[2]." "No one thinks himself miserable except by comparing himself with those who are more happy[3]."

The truth of these propositions depends upon the truth of the whole and the truth of the exception, and hence they may be contradicted in the same way as the exclusives. For example, the assertion of the stoics, that "Except the wise man (formed after their model of wisdom) all men are fools," may be met by maintaining—1st. That the wise man of the stoics was as great a fool as other men; 2ndly. That there were others besides their wise man who were not fools; and 3rdly. That their wise man was really a fool, and many others were not.

Propositions which consist of comparisons involve two judgments: first, the existence of the thing in a peculiar mode; and secondly, the degree which it holds in that mode. Thus the sentence of Syrus: The greatest of all losses is the loss of a friend[4], implies both that the death or estrangement of a friend is a loss, and the greatest of all losses. Also the remark of Horace: "More impression, even in important matters, is produced by a little agreeable raillery, than by the best arguments[5]," implies, in addition to the degrees of the impression, the reality of its existence.

[1] In like manner the exceptive proposition of Terence,
"Imperitus, nisi quod ipse facit, nihil rectum putat,"
has been transformed by Cornelius Gallus into this exclusive:
"Hoc tantum rectum quod facit ipse putat."

[2] Avarus nisi cum moritur, nihil recte facit. P. Syrus, Sent. 62.

[3] Est miser nemo nisi comparatus. Seneca, Troas, 1021.

[4] Amicum perdere, est damnorum maximum. P. Syrus, Sent. 34.

[5] Ridiculum acri
Fortius ac melius magnas plerumque secat res.
Hor. Sat. i. 10.

Hence the truth of comparatives depends upon the truth of the two senses they bear, and may be contradicted by denying either of them; as the maxim of Epicurus, "That pain is the greatest evil," was impugned by the stoics, on the ground that pain was not an evil at all; while the peripatetics, though allowing pain to rank in the category of evils, maintained that vices and other irregularities of the mind were much greater evils.

CHAPTER II.

PROPOSITIONS WITH REGARD TO FORM.

§ 1.—*Quantity of Propositions.*

All propositions are divided into universal, particular, and singular, according to the extent (*i. e.* quantity) to which the predicate is affirmed of the subject. If the predicate is affirmed of the whole of the subject, the proposition is universal; if of a part of it only, the proposition is particular. For example: "All vicious men are miserable;" "No miser is rich;" are universal, and their subject being applied to the attribute in its broadest sense, is said to be *distributed.* But "Some poor men are not unhappy;" "All despots are not cruel," are particular. Their subjects are consequently said to be not *distributed,* being only connected with the attribute according to a certain indeterminate part of their extension.

When the subject of a proposition is a singular term, it is also called singular, as "Colbert first introduced the funding system into France;" "Victoria is worthy of the homage of her subjects:" but as such propositions resemble the universal in having the predicate affirmed of the subject according to the whole of its extension, they are ranked under that head. For it is only essential to the universality of a proposition that its subject be taken in the whole of its sphere; whether that sphere be great or small does not in the least concern it. Single propositions, however, may be fairly reckoned particular when accompanied with a qualifying word, which restricts the attribute to a portion of the subject, as—Non *omnis* moriar: I shall not *altogether* die;

Cæsar was not *wholly* a tyrant. But, strictly speaking, such propositions, admitting of a variation in quantity, are not properly considered singular, the subject being not Cæsar, but the parts of his character[1].

When the subject of the proposition is a common term, the universal signs, "every, all, no, each," are used to signify it is ***distributed,*** and the particular signs, "some, there are," &c., to indicate the contrary. Should the common term, however, be without any sign, the quantity of the proposition, which in that case is termed indefinite, is ascertained by the matter of the judgment, or in other words, the nature of the connexion between the two terms. Where the mind conceives such connexion necessary, either through its inability to conceive the two terms apart, or from its knowledge of their essential association, the proposition which they constitute is deemed universal, as—"Birds are not quadrupeds;" "Circles have their radii equal;" "The planets move in ellipses;" "The elementary atoms of matter combine in definite proportions[2]." Where the connexion is only casual or accidental[3], the proposition will be particular, as—"Birds sing;" "Senators are eloquent;" "Food is necessary to life;" where the matter implies that the predicate cannot be said of the entire class of objects for which the subject of the proposition stands[4]. Should the nature of the connexion, however, be

[1] Whately's Logic, b. ii. ch. ii. § 2. [2] Though the matter of these propositions, *i. e.* the connexion between their terms, is not equally necessary, since the negation of the two first examples would be inconceivable, while the denial of the two last would suppose no absurdity; yet, since the necessity of the connexion of the terms of the latter depends upon the laws of nature, its competency to imply a universal may be presumed equal to the former. [3] Archbishop Whately, after Aldrich, calls this kind of connexion contingent. But that phrase is applied by the scholastics, and their modern successors, as also by Kant, to denote that class of facts which depend upon natural laws as contradistinguished from absolute truths which cannot be conceived otherwise than they are. In that sense, the word would exclude many instances of necessary connexion, and is therefore likely to mislead. [4] The Port Royal logicians cavil with the idea of the distinction between necessary and accidental matter as affording a clue to the quantity of indefinites, and would substitute doctrine and circumstances of fact in their place. Logique, part ii. ch. xiii. Thus: Angels have no body—being a matter of doc-

doubtful, it is evident, since we can only affirm or deny the predicate of those cases in which we have tested the certainty of our judgment, that the proposition must be particular. Hence indefinite propositions have no place in the logical system, and are only mentioned here to put the reader on his guard against them[1].

§ 2.—*Quality of Propositions.*

The division of propositions into affirmative and negative gives rise to their quality; an affirmate proposition, of course, being that whose copula is affirmative, as "fish breathe;" and a negative one whose copula is negative, as "misers are not happy."

Some logicians, however, hold[2] that there is in reality no negative in thought, but only in the form of expression. To say "Adeline" is not tall, is to say that she is short. This is correct in those cases where the negative is not referred to the verb, but to one of the terms. For then we regard the predicate, or subject, as a thing limited—that is, as a positive thing deprived of some property. For example: Human knowledge is not perfect, is equivalent to human knowledge is imperfect; and some graduates are not learned, is equal to some graduates are unlearned; but when the negative is referred to the verb, the proposition must be considered negative as respects the form, otherwise we might argue that no proposition could be considered affirmative, as every judgment is capable of assuming a negative form.

The quality or form of a proposition may be either simple (pure) or complex, as well as its matter. Thus—"Cæsar loved Cleopatra," is an instance of the simple kind of affirmation. "Copernicus proved demonstratively that the Heliocentric theory was true," is an example of the second; for

trine, is universal; while: Soldiers were engaged in review—being one of fact, is particular. But this, in reality, is only expressing the same distinction in theological language. [1] Logicians, however, distinguish a species of moral universality, which, though not without exception as in the case of absolute or metaphysical universality, yet are sufficiently approximate to enable us to found an argument upon them, as—Women are talkative; Old men are prudent. Professor de Morgan calls attention to these under the head of plurative judgments (Formal Logic, p. 325). [2] De Stutt Tracy, Grammaire, part i. c. 4.

the terms "Copernicus proved demonstratively" is only alleged in support of the affirmation that the Heliocentric theory is true, and consequently does not fall upon the matter but upon the form.

Cases, however, sometimes occur where the complexity may be applied to both, and, according as it is so taken, completely change the meaning of the sentence; as "Locke asserts that all our ideas have their origin in sensation and reflection," may imply a wish on the part of him who utters it to uphold that doctrine; in which case the first part of the sentence, "Locke asserts it," must be regarded as an incidental proposition adduced in support of the affirmation in the latter: or it may denote an intention to express this doctrine as the opinion of philosophers without affirming anything about its truth; in which case the first part, viz., "Locke asserts," would become the principal proposition, and the last would only form a portion of the attribute. The complexity then would fall upon the matter, but the signification would be entirely changed. In such ambiguous phrases, however, the nature of the incidental proposition may easily be collected from the intention of the speaker or writer.

Many logicians in this place consider the morality of propositions—that is, the degree of certainty with which the mind affirms or denies the connexion between the terms of any proposition it may entertain. Of these there are many gradations, as each person may ascertain by consulting his own consciousness; but as their explication would involve the question of the foundations of evidence, we join the modern schoolmen in relegating them from this part of logic.

§ 3.—*Distribution of Terms in Propositions.*

We have said the subject of a universal proposition is distributed, since it is taken in the whole extent of its signification; and the subject of a particular proposition undistributed, because only some of its parts are applied to or excluded from the predicate. Hence it follows, that the distribution of the subject depends upon the quantity of a proposition, and is distributed in universals, and in universals alone.

The distribution of the predicate, on the other hand, depends on the quality of a proposition. For it is sufficient

to admit the predicate to be affirmed with truth of the subject, that some part of it should agree with the subject; we consequently cannot infer that it is taken in its whole extent from the bare act of affirmation. But for a negative to be true, it is necessary that the entire predicate should be excluded from the subject. To fulfil this condition, therefore, in every negative proposition the predicate must be distributed. Hence the two practical rules generally given for distribution are, that none but universals distribute the subject, and none but negatives distribute the predicate.

But the last rule is not to be taken absolutely, since affirmative propositions occasionally distribute the predicate; as in those cases where the proposition assumes the form of a definition, as common salt is chloride of sodium; some animals are all men; and we may even conceive cases in which the rule is entirely overridden, as, "some trees are not some plants;" "no sinners are some men," where the predicate is quantified in common with the subject. But such propositions are evidently unnatural in their present form, and, if not entirely nugatory when transformed to their conventional shape, may be brought under the two rules already given. Thus, "some animals are all men" is equivalent, according to the first rule, to "all men are animals," and in ordinary parlance, never appears in any other form. Again, the negative proposition that "no publicans are some men," does not preclude our constructing an affirmative judgment out of the same terms, as "all publicans are men." Not having, therefore, the force of a negative, it never occurs in speech, and is consequently useless. But a negative proposition which contains two particular terms, as "some lichens are not some plants," is still more nugatory, as it might be affirmed of everything not only existing, but even identical. For if we define common salt to be chloride of sodium, we may, nevertheless, affirm that some common salt is not some chloride of sodium, meaning, of course, that the common salt in this salt-cellar is not the chloride of sodium in that[1].

It is not essential to clearness of thought that the predicate be quantified—*i. e.* have a determinate quantity either in judgment or expression. In affirming the agree-

[1] Thompson's Laws of Thought, p. 188, 2nd ed.

ment or disagreement of two ideas, the mind concentrates its attention upon the double sphere of the subject, and never looks further into the nature of the predicate than is sufficient to enable it to affirm or deny it of the subject. To this end it is by no means necessary that the logical sphere of the predicate be known, at least in affirmative cases, but only such parts of its connotation as are either identical with the subject, or so distinct from it as to imply the non-agreement of the rest of its properties. Thus, when we say "all men are sinners," we pay no attention to the extent to which "sinners" may be affirmed of other objects besides men, it being a law of the mind never to examine further into the nature of the terms upon which it has to decide than the correctness of the judgment warrants. For this purpose it is evidently sufficient to know that each man is peccable without inquiring what other things are so. So much, indeed, is this the case, that in affirming "all men are sinners," very few, unless theologians, upon whom the question has been forced by abstract study, have ever dreamt of asking themselves whether "all men are all sinners," or whether "all men are some sinners," that is, whether the term can be applied to angels and devils also, and even if some brutes are not included under it[1]. Again, it is so far from being essential to the clearness of the proposition, "some men are not rational," to know whether rational is taken in its universal or particular sense, that the very suggestion of its quantification is apt to confuse the judgment in pronouncing it.

Indeed, so foreign is the effort of realising "the new analytic" to the mind, that the thing would never have been dreamt of had not Sir W. Hamilton been led to it by the development of the general idea of predicate quantification;

[1] We have gone into this case at some length, as the contrary opinion has been distinctly put forth in favour of a thorough-going quantification of the predicate, on the ground of its absolute necessity to the formation of clear judgments, by Spencer Baynes—a writer of some promise—in his "New Analytic of Logical Forms," which is simply intended to state the views of Sir W. Hamilton as to the extensive and beneficial nature of the changes which such quantification is calculated to introduce into logic. Mr. Baynes in that work hazards the assertion that "the quantity of the predicate is always contained in thought," a statement which appears to us, as in the example cited in the text, to be almost exactly the reverse of the truth.

yet no one, surely, would be bold enough to assert that every judgment formed up to this time was less clear, from the fact that mankind had never attended to its twofold quantification. The obliviousness in which the particular details of the general doctrine lay buried[1], is the very proof required to show that the mind does not need them, and, in fact, never adverts to them in the formation of its judgments, since the agreement or disagreement which such acts pronounce can be ascertained with certainty without further knowledge than the double sphere of the subject and the connotation (metaphysical sphere) of the predicate afford.

The propositions which we have examined in connexion with a quantified predicate, if combined with those which arise out of a quantified subject, will, it is evident, embrace every conceivable mode of affirmative predication; and we need only negative each proposition it contains to get every conceivable mode of negative proposition, and thus complete the list of simple categorical propositions real as well as possible. Annexing corresponding signs to each of these for the sake of brevity, they stand thus:

Predicate distributed in conformity with rule.	Quantity.	Quality.	Signs.
All planets move in ellipses .	Universal	Affirmative	*a*
No unjust action is expedient	Universal	Negative	*e*
Some muscles act without our volition	Particular	Affirmative	*i*
Some rocks are not granite .	Particular	Negative	*o*
Predicate distributed against rule.			
Common salt is chloride of sodium	Universal	Affirmative	*x*
Some plants are all lichens .	Particular	Affirmative	*y*
No rational animals are some men	Universal	Negative	*u*
Some flowers are not some rosadendrons	Particular	Negative	*z*

[1] Mr. Baynes seems hardly to have been aware that in advancing his master's (Sir W. Hamilton) claims to originality in the development of the doctrine, he was only proving its absolute inutility for all the practical purposes of logic. He first writes a treatise to show that

An examination of the above table will lead to the conclusion already pointed out, that all the propositions, the predicate of which is distributed or quantified against the rule, save *x*, are unnatural, and, as such, never used; and that with regard to *x* the predicate is not strictly, but merely casually, definitive; not being implied in the form of the expression. It will be, moreover, seen that the import of *y*, *u*, and *z*, find their correct expression in a natural form only when their terms are arranged to bring them under *a*, *e*, *i*, *o*; we consequently are led to reject the four other forms of judgments as worthless, so far as practical logic is concerned, and rest satisfied with the rule already given as sufficiently indicative of the logical sphere of the predicate[1]; viz., that all universals and no particulars distribute the subject; all negatives and no affirmatives distribute the predicate: and thus we have *a* distributing its subject, *e* both its terms, *i* neither, and *o* its predicate.

§ 4.—*Opposition of Propositions.*

Opposition of propositions is simply the relation of the agreement or disagreement of propositions which have the same subject and predicate, (matter), but a different quantity

the quantification of the predicate is essentially necessary to the formation of accurate judgments; in fact, invariably accompanies such mental acts, and then proves, by way of appendix, that no person ever had such quantification in mind but Sir W. Hamilton. Is not the effect of this procedure clearly to intimate that clear conceptions have been hitherto unknown, or to land Mr. Baynes in a flat contradiction? The dilemma is inevitable, and Mr. Baynes must choose his horn.

1 In rejecting the express quantification of the predicate we find ourselves in respectable company. Aristotle (De Enunciandi Ratione, c. vii., and in Anal. Prior, i. c. 27, § 9) also rejects it on the ground of its futility; and is followed by nearly all his commentators, including Boethius (Opera Omnia, Basil, p. 348); Averroes (Opera Omnia, Venit. b. i. fol. 45); and Palius, in Arist. de Interp. c. vii., and Anat. Prior, c. 27, § 9, fol. 46. Ambrosius Leo appears the most inclined to treat it with favour; but this arose from his antagonism to Averroes, every one of whose opinions he made it a point to dispute (Castig. Ad. Aver. in Lib. de Interpret.) Isenach, one of Luther's tutors, also coquetted with the doctrine, in his Breviarum Dialectica, a divine attached to the old opinions, whom, Luther says, he killed by expressing before him his withering contempt for scholasticism. For a development of Isenach's views on the quantification of the predicate, see Mr. Baynes's Appendix to his New Analytic.

and quality, or both, (form). As we can run any given subject, and predicate through the four simple categorical propositions *a*, *e*, *i*, *o*, forming a distinct judgment in each, any two of which may be said to be opposed, it follows there are four different kinds of opposition—viz., 1stly, the two universals (*a* and *e*), which are called contraries to each other, as "every man is a responsible agent," "no man is a responsible agent;" 2ndly, the two particulars (*i* and *o*), which are called subcontraries, as "some man is a responsible agent," "some man is not a responsible agent;" these two cases differ only in quality, but agree in quantity; 3rdly, *a* and *i*, or *e* and *o*, which differ in quantity, but agree in quality, as "every angel is a rational creature," "some angel is a rational creature;" "no metal is incapable of being magnetised," "some metal is not incapable of being magnetised;" which kind of propositions are called subalternans: 4thly, *a* and *o*, *e* and *i*, which differing both in quality and quantity, are called contradictories, as "all muscat is fruit," "some muscat is not fruit;" "no forms of government are exempt from change," "some form of governments are exempt from change."

In considering these propositions it will be observed that contraries can never be both true, though they may be both false. For, if it be true that every man is accountable for his actions, it is false that some man is not accountable for his actions, which is the contradictory; and still more false, that no "man is accountable for his actions," which is the contrary. But the falsehood of the one does not imply the truth of the other. For example, if it should be false that all men have a right to freedom, it would not follow that, therefore, no men have.

Subcontraries may be both true, but cannot be both false, as "some men are rich," "some men are not rich," may be both true if we do not consider the negation to regard the same subject as the affirmation; but it is evident they cannot be both false, unless we are prepared to assert a man can be rich and not rich at the same time. It may, however, be observed, that there is no real contrariety where the subject of the propositions are not identical, and that consequently the term subcontrary is entirely arbitrary and unmeaning.

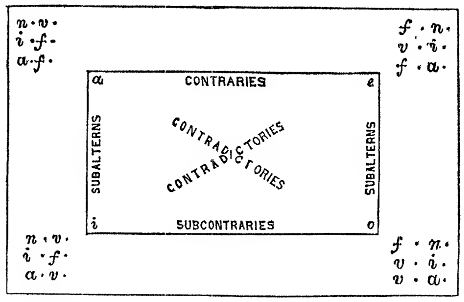
There is also no true opposition in the case of subalternans, since the particulars are consequences of the general, so that

the relation between them is one of partial agreement. For if "all geraniums are flowers," "some geranium is a flower," and if "no man is faultless," "some man is not faultless." But it will be at once seen that the truth of the particulars does not imply the truth of the universals, though their falsity does; and that the falsity of the universals does not imply that of the particulars. Hence it is evident that there are many cases in which these subalternate propositions are both true, and others in which they are both false.

The opposition of contradictories is more perfect than any of the others, as they are never both either true or false together; and hence, if any proposition is known to be true, we infer that its contradictory is false; if false, that its contradictory is true. For example, if every man is a dependent creature, it cannot be true that some man is not a dependent creature, and if, contrariwise, it be true that some man is not a dependent creature, it is consequently untrue that every man is a dependent creature.

It is important to observe, as the truth or falsity of any proposition must depend upon the nature of the connexion between the two terms, that in necessary matter all affirmatives are true, and negatives false: thus, all the radii of a circle are equal, is an instance of the first; no radii of a circle are equal, or some radii of a circle are not equal, is a case of the second: that in accidental matter all universals are false, and particulars true; as, all islands are fertile, no islands are fertile, are both false, but become true by substituting "some" for "all" and "no:" that in impossible matter all affirmatives are false, and negatives true, as is evident from the nature of the case. By this means, from the nature of the matter, we shall at once be enabled to decide upon the truth or falsity of the judgments in every scale of opposition; as, *e.g.* in accidental matter, contraries will be both false, but never both true; sub-contraries both true, but never both false; and contradictories always one true and the other false.

Denoting the four propositions by their symbols, and the truth or falsity of each proposition in each matter by the letter *V.* for (*verum*) true, and *F.* for (*falsum*) false, the entire doctrine of opposition, and everything which pertains to it, may be elicited from the adjoining scheme.



For practical purposes opposition is important, as showing the force of any assertion, exhibiting the power which it has of resisting any argument brought against it, or against which it is brought.

§ 5.—*Conversion of Propositions.*

The conversion of propositions consists in the transposition of their terms, that is, in making the subject the predicate, and the predicate the subject, without affecting the truth of the original proposition. To ensure this it is evident that the quality of the judgment must be preserved, and no term distributed in the converse that was not distributed in the convertend. For example, because " all salts are fusible," we cannot infer that all fusible things are salts; for in that case we would employ the predicate universally in the converse, which was only taken particularly in the convertend.

When the distribution of the terms, however, is not affected by the simple transformation of the subject and predicate, the conversion is legitimate, the truth of the converse being expressly implied in that of the convertend, as—

No charlatan is a patriot; therefore
No patriot is a charlatan.

Some boasters are cowards; therefore
Some cowards are boasters.

But this species of conversion, which is called simple, only occurs with *e* and *i*, the first of which distributes both its terms, and the last neither.

But in those propositions which distribute only one of

their terms, simple conversion would not be legitimate, as in *a;* and to render the terms in the converse equivalent to those in the convertend, we must affix the word some to the predicate. Thus, though we cannot infer from

All birds are animals, that
All animals are birds,

we can, by limiting the predicate in the converse to the exact extension it holds in the convertend, effect a legitimate conversion, as—

All birds are animals,
Some animals are birds.

This species of conversion is consequently known by the name conversion by limitation: *e* may thus be converted, but *a* is generally so.

The proposition *o*, however, is inconvertible by either of these methods, since, whether the quantity be changed or not, the predicate of the converse will remain undistributed, which was not so in the convertend. We are, consequently, obliged, in order to effect its conversion, to reduce the proposition to *i*, by considering *not* as prefixed to the predicate, instead of to the copula. It may then of course be converted simply, that is, by the mere transformation of its terms, the subject assuming the form of an incidental proposition. Thus, "some members of the university are not learned" is equivalent to some members of the university are not-learned, or some who are not learned are members of the university. This may be termed conversion by negation, or, as it is commonly called, by contraposition. Not alone *o*, but every proposition may be converted in this way[1]. Hence we may conclude, that in one of these three modes every proposition may be legitimately converted; *e* and *i* simply, *a e* by limitation, and *o*, *a*, *e*, and *i* by negation[2].

An attempt has been made to get rid of the doctrine of conversion thus propounded by introducing the quantification

[1] Archbishop Whately says only *a*, but if the student chooses to try, he will find the conversion applicable to each of the four categorical propositions. [2] It may appear that *a* is capable of simple conversion, as in definitions where the predicate is identical with the subject, but as its truth does not follow from the original proposition, there is no conversion in the case, the resulting converse being a different judgment, and not the same judgment in another form.

of the predicate, which would reduce the whole affair to a mere transformation of terms[1]. The simplification, however, if at all practicable, would be purchased at the expense of utility. Take the most complex form which the old doctrine assumes, that of conversion by negation, and transform the terms of a proposition in *o*, after having quantified the predicate. By this process, the proposition "some metals are not all conductors" would become "all conductors are not some metals," or "no conductors are some metals." Of what conceivable use can the latter judgment be, which the first is not able more properly to effect? Conversion in such cases would frustrate every purpose it is instituted to effect by reducing a proposition from a form in which it is of some use, as conveying substantial information, to another in which it is deprived of a determinate meaning; for it cannot concern us to know that no metals are some conductors, since there may be other conductors which are some metals. Yet only in the conversion of *o* could the quantification of the predicate effect any direct simplification. For the conversion of *a*, the sole case where its application is admissible, cannot be more simply provided for than by the old rule; while that of *e*, by limitation, if effected in accordance with the quantification of the predicate, would lead to the inference of a particular proposition where a universal might be drawn, and consequently be so far nugatory.

It appears to us that the advocates of a complete quantification of the predicate are so absorbed in the means which logic employs, as to lose sight of the ends they are intended to effect. The object of conversion is to enable us to throw a proposition either into a clearer form or into one more fitted to sustain the argument which we may be endeavouring to establish. But either of these purposes must be defeated by crowding the brain with a series of unnatural propositions, such as the quantification of the predicate would generate, which are never used in ordinary discourse, simply because the mind never considers them adequate either to express the clearness or the force of its conceptions. Even in the supposition of their competency, they could not be substituted for those forms of conversion which logic already employs, each of which has its peculiar functions to fulfil in

[1] Mr. Baynes's New Analytic, which expresses Sir W. Hamilton's views, and bears his *imprimatur*.

the hands of the dialectician. To take the conversion by contraposition, which is the one against which there is the most complaint, its striking importance is manifest in enabling us to throw a proposition into the negative form, when that form will more easily lead to the establishment of our position than any other; as is done by Paley in proving the main proposition of his Evidences. The means may be cumbrous; but a complex arrangement is often required to gain the end in view, where a more simple instrument would fail. No doubt the Cuirassiers at Waterloo felt their armour an encumbrance; but had they exchanged their plates of mail for woollen coats, would they have done their work so well, or, rather, would they have been allowed to do their work at all?

BOOK III.

SYLLOGISMS.—PROEMIUM.

As the combination of two or more terms leads to the expression of a judgment concerning their agreement or difference, so the union of two or more propositions is essential to the formation of inference; or, in other words, we reason from a comparison of propositions, as we may be said to judge from a comparison of terms. But in order that two propositions may unite to form a distinct judgment, it is necessary they should express something concerning the same object; or, in other words, that they have one term in common: the agreement or disagreement of the common term with the other terms involved, will then lead to the enunciation of a new judgment, declaratory of the relation in which the dissimilar terms stand to each other. The evolution of such a judgment from two antecedent propositions asserting something concerning a common term, is an instance of one of the simplest forms of reasoning; and the formal statement of the propositions concerned, in their sequential order, is called a syllogism. Thus:

All planets move in ellipses;
But Mercury, Mars, and Venus, are planets,
Therefore they move in ellipses.

Though every illative process implies three judgments, in two of which one term is compared with two others, in order that the relation between these last may be accurately determined in a conclusive proposition; yet this number of judgments is by no means necessary for every sort of inference. As we have already seen in the opposition and conversion of propositions, we can make a series of inferences from two terms; as from the fact of man being mortal, it is competent to any one to infer that some mortal beings are men, or that no man can be immortal; that immortal beings are not men, and that he who honours a man honours a mortal; but such inferences do not embrace any illative process—that is, the evolution of any new judgment different from the one already expressed, but only the same judgment in a different form; and, therefore, are properly excluded from the domain of strict reasoning, which is only employed in eliciting new truths, or in presenting those already discovered in a demonstrative form to others[1]. Each inference in the case of strict reasoning, when completely analysed, will be found to depend upon three or more such propositions, as we have

[1] The reader must have his eye on this distinction, as it appears to us that the losing sight of it has betrayed some distinguished writers into an erroneous conception of the nature of reasoning. Thus Dugald Stewart resolves the whole process into intuition and memory, and presents us with a case of immediate inference, which the first kind is generally called, as an instance of reasoning in which three judgments are irrelevant, and then proceeds to reject the Aristotelic theory on account of its non-applicability to a case in which there is really no reasoning at all!! (Phil. Hum. Mind, b. iii. c. ii. § 1.) Mr. Samuel Bailey, in his recent able Essay on the Theory of Reasoning, seems to fall into the same error, in citing similar cases of reasoning (?) as unrecognised by, and foreign to, the Aristotelic syllogism (p. 83), as "all men are fallible," "this man is fallible." Locke (Hum. Und. b. iv. § 15), who, in this and other places, seems above his disciples, restricts reasoning to the sense in which we have taken it, and insists upon the distinction above laid down between the two kinds of inference, one of which he calls immediate, the other mediate. All the writers who adopt Stewart's views confound the relation between the formal identity of a syllogism—viz., the necessity of the conclusion, if the premises be true, with its material identity—viz., the identical truth of each of the three judgments. Though we see the former intuitively, we do not see the latter. A middle term is necessary to distinguish it. Truth, like life, is propagated by union:—two verities must unite to produce a third.

described; and the properties which attach to them in their syllogistic union, and the multiform modes in which they may be combined, will form the subject of the present book.

Under the former head we shall treat of the one great canon of mediate inference, and the general rules which are to be observed in its application; the moods and figures will follow with their special canons and rules, and the number of valid cases of inferences to which these lead will be contrasted with the more enlarged series which a complete quantification of the predicate is said to establish. The second portion will comprise the different kinds of syllogisms with the laws of the reduction of the more complex to a simple categorical form, to which the syllogistic rules and canons are more applicable. In this book, therefore, we restrict ourselves to the naked syllogism as the inferential link out of which the chain of proof is constructed. How these links are bound together in the evolution of new truths, or in conclusive lines of demonstration; the inductive and deductive forms they usually assume with the laws of their combinations; the grounds on which all proof rests, and the various axioms which legitimise and discriminate its different degrees of certainty; are evidently matters which regard a higher step in the treatise than simple inference, and may be regarded, in Lord Bacon's manner, as certain *prodromi*, or anticipations which prepare the way for the consideration of the consecutive forms of reasoning which are to engage our attention in the different sciences. As such we shall consider them apart in the next two books.

CHAPTER I.

PROPERTIES OF SYLLOGISMS.

§ 1.—*Universal Canon of Mediate Inference with the General Rules of the Syllogism.*

As all reasoning may be virtually resolved into a comparison of two terms with a common third term, with a view to ascertain their respective relations to each other, the geometrical axiom—viz., two things which are equal to a

third thing are equal to each other—which underlies all mathematical inference, may be said to be fundamental to every kind of valid inference on whatever matter employed[1]; but to transform this axiom into the universal canon of inference, in such a manner that it shall prospectively embrace all the general rules, requires a preliminary remark respecting the sense of the word relation.

Two terms are said to be related when they stand to each other in the position of subject and attribute; but this relation varies in degree according to the different quantity and quality of the proposition in which it is expressed. Thus, if a subject stand to an attribute in the relation of a universal to a particular, the relation of the attribute to the subject is said to be inferior to that of the subject with the attribute, because the latter embraces fewer objects; and, in like manner, if a common term be affirmed of one object, and denied or excluded from another, the relation in which such term stands to the latter is called inferior to that of affirmation, since it is much more definitive to affirm than to deny. Hence when two terms, *taken in the same extension*, are contrasted affirmatively with a common third term, no difference of relation occurs between them—in other words, the relation is termed equal; but when one is applied either particularly or negatively to a common term, while the other is taken universally and affirmatively, the relation of the former is said to be inferior to that of the latter. With this proviso, we may take the universal canon of reasoning to be: *What equal or inferior relation subsists between either of two terms and a common third term, with which both are related, and one at least positively so, that relation subsists between the two terms themselves*[2]. Observing this canon, no syllogism can be formally invalid, and we shall see the reason of this by tracing the manner in which it folds up within itself the general rules of the syllogism.

1st. Every syllogism must contain no more than three terms. Of these, the two whose relation is to be proved

[1] See Bacon's Primary Philosophy, De Aug. b. iii. c. 2: "*Quæ in eodem tertio conveniunt inter se conveniunt,*" regula est itidem ex mathematicis; *verum simul tam potens in logica ut syllogismi sit fundamentum.* [2] This canon, with a little alteration, we have taken from Sir W. Hamilton. See Mr. Baynes's New Analytic.

are called the extremes of the conclusion, or question; and the term, by which their relation is proved, is called the middle. Of the extremes, again, the subject of the conclusion is called the minor term, and that which stands as predicate the major term[1].

The term major has been applied to the attribute of the conclusion, and minor to the subject, because in the most natural form of inference[2], the major was by its position the most extensive, and the minor least. Thus, in the syllogism: All wise men are circumspect; but Solon was a wise man; therefore, Solon was circumspect; circumspect, the major term, is more extensive than Solon, the minor, for we include Solon and all other wise men in circumspect. When the conclusion, however, is either particular or negative, it is impossible to ascertain the relative magnitude between the two terms. There is nothing to prevent in such cases the so-called major term from being much less than the minor, though there is always a presumption in favour of the contrary case, arising from the mental habit of restricting the subject and leaving the predicate unquantified.

The fulfilment of this rule is secured by that part of the canon which enjoins the relation of two terms with a common third term by way of subject and predicate: but this does not prevent one of the propositions from being conjunctive, that is, from including several distinct terms under it; for so long as one predicate is affirmed of them, such plural subjects are logically considered as one term. The rule is directly aimed against the assumption of two middle terms, since, in that case, the extremes, or terms of the conclusion, not being both compared to the same term, could not be conclusively compared to each other.

2nd. Every syllogism can embrace only three judgments, viz., those commonly called the premises, in which the extremes are respectively compared to the middle, and the

[1] In Greek, major = τὸ ἀκρόν
minor = τὸ ἕτερον
middle = τὸ μέσον

[2] The first mood of the first figure. See next section.

conclusion in which the relation of the two extremes is expressed. Of the premises, that in which the middle term is compared with the major or attribute of the conclusion, is styled the major premiss, and that in which the middle is compared with the minor, or subject of the conclusion, is termed the minor premiss.

There may be some combinations of more than three propositions, which seem to present simple cases of inference; but if all such are carefully analysed, they will be found to resolve themselves into plural inferences, each of which, when fully expressed, expands into a distinct syllogism, with a triplex judgment. The rule, therefore, strictly holds under every circumstance, and, indeed, may be considered as a necessary corollary of that part of the canon which ensures the first rule. For if there be only three terms, each of which is to be compared once only with the two others, it is evident there can be only three judgments, viz., those which express the three acts of comparison, since three terms cannot be incorporated in more than three propositions without repetition[1].

3rd. The middle term must be distributed once at least in the premises, which is ensured by making it either the subject of a universal, or the predicate of a negative; for if it be taken particularly in both of the premises, one of the extremes may happen to be compared with one part of its extension, and the other with the other part, as:

> The wise are good;
> Some ignorant people are good;
> Therefore, some ignorant people are wise.

Here the term good being undistributed, is applied to two different classes of people, and in that double sense predicated of ignorant and wise. These extremes are consequently compared with two different parts of the term good, so that in lieu of one middle term we have two, against the express sanction of the canon. The same illusion equally obtains where the middle term is ambiguous or equivocal, for in such instances two different senses may be struck out of the word, and the same error committed as

[1] Thompson's Laws of Thought, p. 231, 2nd ed.

if the term had remained undistributed. To cite a glaring instance:

> Light is contrary to darkness,
> Feathers are light;
> Therefore, feathers are contrary to darkness[1].

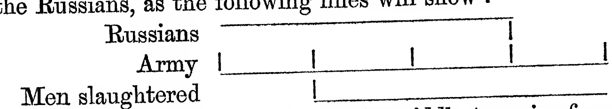
As the purport of the rule, however, is to secure the comparison of each of the extremes with the whole or the same part of the middle, this, it has been argued, may be obtained[2] without an express distribution of the middle; as when, instead of introducing every part of a third term, we specify what part of it, is intended to be taken in both premises; but we cannot so specify the part of the middle without rendering it a singular term, and such we have seen are universal, and consequently distributive. Thus, from the premises:

> Three-fourths of the army were Russians,
> Three-fourths of the army were slaughtered;

we may fairly infer that

> Some who were slaughtered were Russians.

For, even supposing the whole of the remaining fourth that were slaughtered were Turks, there would still remain two-fourths in the second premiss to be put to the account of the Russians, as the following lines will show:



But it is evident that in this case the middle term is of a singular character, and consequently universal, and as such distributed in both premises.

4th. No term must be distributed in the conclusion which was not distributed in one of the premises, since that would be to employ the whole of a term in the conclusion, when only a part of it had been employed in the premises, which is in reality equivalent to the introduction of a fourth term. Thus:

> Edward is melancholy,
> Edward is wise;
> Therefore all wise men are melancholy.

1 Archbishop Whately's Logic, b. ii. c. iii. § 2. 2 Thompson's Laws of Thought, p. 237.

Again:

All quadrupeds are animals,
A bird is not a quadruped;
Therefore it is not an animal.

In the first example, the minor term is taken more extensively in the conclusion than in the premises—an act which is called illicit process of the minor; in the second example, the major term is in the same position, and is similarly termed an illicit process of the minor. Between the two instances there is, however, this difference, that the illicit process of the major is far the worse fault, as in that case we are not entitled to draw any conclusion at all; but in the other we only draw a universal in place of a particular. This rule is expressly provided for by that part of the canon which directs that the terms be expressed in the conclusion according to the inferior relation which they hold in the premises.

5th. From negative premises we can infer nothing; consequently one must be affirmative. For if both extremes are said to disagree with the middle term, they cannot be compared together. Thus, from

Every wise man is not amiable,
No miser is wise,

we can infer nothing. This rule is expressed in the canon by the clause enjoining that one of the extremes shall be connected with the common third term positively.

6th. If one premiss be negative, the conclusion must be negative. For in that premiss the middle term is pronounced to disagree with one of the extremes, and in the other premiss, which must by the preceding rule be affirmative, to agree with the other extreme; but extremes which disagree with each other can only lead to a negative conclusion. This rule is also secured by that part of the canon already quoted as involving the fourth rule; viz., that the conclusion must follow the inferior relation of the extremes in the premises.

These rules in the common school logics are extended to eight, and are thus expressed in hexameters:

Terminus esto triplex medius majorque minorque:
Latius hos quam præmissæ conclusio non vult:
Nequaquem medium capiat conclusio oportet:
Aut semel aut iterum medium generaliter esto:

Utraque si præmissa neget, nihil inde sequitur:
Ambæ affirmantes nequeunt generare negentem:
Nil sequitur geminis ex particularibus unquam:
Pejorem sequitur semper conclusio partem.

But if these are examined, the remaining two will be found to be included in the ones we have already particularised. For example, the third and fourth rule preclude all inference from two particular premises, because the resulting syllogism would involve either an undistributed middle or an illicit process. As:

Some minerals are crystals,
Some stones are not crystals;
Therefore some stones are not minerals.

The fourth rule, also, collaterally implies, that if one of the premises be particular, the conclusion must be particular, in accordance with the canon, that the terms in the conclusion must follow the inferior relation, if such exist, which obtained in the premises. For, the inferring a universal conclusion in that case would lead to the illicit process of the minor. Thus, from

All who live virtuously deserve esteem,
Some Pagans lived virtuously,

we can only infer that

Some Pagans deserve esteem.

It may also be remarked, that several of the rules assign the conditions for the existence of a syllogism rather than afford any direct test of its validity. It is likewise important to remember that all the general rules already given are not to be regarded as something distinct from the canon, but as a detailed exposition of its principles, intended to secure in all cases every illative process from error.

§ 2.—*Figures of the Syllogism.*

The figure of a syllogism is determined by the situation of the middle term when compared with the extremes of the conclusion in the premises. This may obviously vary in four different ways. For the middle term can either be the subject of the major premiss, and the predicate of the minor, which is the first figure; or the predicate of the major premiss, and the subject of the minor, which is the fourth figure; or the

predicate of both premises, which forms the second figure; or the subject of both, which constitutes the third figure. Using the initial letters of the different terms, in lieu of concrete exemplifications, the scheme may be thus expressed:

1st fig.	2nd fig.	3rd fig.	4th fig.
M, P,	P, M,	M, P,	P, M,
O, M,	I, M,	M, S,	M, S,
∴ S, P,	∴ S, P,	∴ S, P,	∴ S, P.

Each of these figures have their respective rules, which, however, are involved in the universal canon and the rules already given; and only lead to a separate statement, by way of caution, that none of the figures may violate the principles of the rules already given. Though the reader might easily evolve these special rules, from an examination of each figure in connexion with the main canon, we will state them at length, together with the laws or principles which the four figures exemplify.

The construction of the first figure requires the major premiss to be universal, and the minor affirmative; as in the celebrated argument of Aristotle[1], to prove the inseparable union of the virtues:

He who possesses prudence possesses all virtue,
He who possesses one virtue must possess prudence;
Therefore he who possesses one virtue possesses all.

For if the minor were negative, the major must be affirmative by the fifth general rule, and the conclusion negative by the sixth; the greater term, which is taken only particularly in the major premiss, would then be taken universally in the conclusion, in contravention of the fourth rule. Now, if the minor must be affirmative, the major premiss must be universal, otherwise the middle term, being the subject of the latter, and the predicate of the former, would be taken twice particularly, against the third rule.

The principle or law which the first figure exemplifies, is the celebrated *dictum de omni et nullo*, which Aristotle supposed to be inclusive of all reasoning. It may be thus expressed: "Whatever is affirmed or denied of a class may be affirmed or denied of any part of that class[2]." So that if

[1] Eth. b. vi. *passim*. [2] Arist. Cat. ch. v., and Pri. An. i. ch. v. and vi. See Bohn's Scientific Library.

one attributes to men free agency, we may also affirm it of Ethiopians as part of the class men; or if it is denied that brutes are thinking beings, we may also aver the same of apes, which are included in the same category. Whatever be the subject-matter, this figure invariably illustrates the same principle; since in it the greater term is affirmed or denied of the middle, taken universally, and this same middle is again affirmed of the lesser term, in a particular sense, which makes the subject of the conclusion stand in the same relation to the subject of the major premiss as part to a whole, and consequently produces a subordination of classes.

The first figure is generally deemed the most perfect, because all the propositions, *a*, *e*, *i*, *o*, can be proved by it, and a universal affirmative by it alone[1]. The reason of the latter is, that with a view to make the conclusion a universal affirmative, the lesser term must be taken generally in the minor, and consequently form its subject; but the middle term being the predicate of the minor, is particular, whence arises the necessity of taking it universally in the major where it is the subject. But this can only occur in the first figure.

Since the second figure is that in which the middle term is taken twice as attribute, it requires two cautions, with a view to secure its adherence to the general rules of the universal canon. The first is, that one of the premises, and consequently the conclusion must be negative; and secondly, that the major proposition must be universal; as in Cicero's argument against the Epicureans[2].

All true philosophers regard virtue as a good in itself,
But the Epicureans do not reckon virtue a good in itself;
Therefore the Epicureans are not true philosophers.

For if both propositions in this syllogism were affirmative, the middle, which in this figure is always the attribute, would be taken twice particularly, against the third rule; and since the greater term is universally taken in the conclusion, it cannot be taken particularly in the major premiss, where it is the subject without an illicit process, which the fourth rule directly forbids.

[1] Not as Mr. Thompson states (Laws of Thought, p. 242), because it more directly exemplifies the dictum *de omni et nullo*. [2] De Officiis, b. i. and ii.

The second figure illustrates the *dictum de diverso*, being founded on the axiom, "If one term is contained in, and another excluded from a third term, they are mutually excluded," and is obviously useful for showing the differences of things, and remedying the confusion arising from indistinct conceptions. For instance, when we have to disprove something that has been maintained, or is likely to be believed, we show that the thing we are speaking of cannot belong to such a class, either because it wants what belongs to the whole of that class, or because it has something of which that class is destitute; in either case the inference will fall into the second figure.

As the middle term in the third figure is twice taken as subject, it follows, with a view to the observance of the canon, that the minor proposition must be affirmative, and the conclusion particular; as in Adam Smith's reasoning on the moral sentiments[1],

Prudence has for its object the benefit of individuals;
But prudence is a virtue; therefore
Some virtue has for its object the benefit of the individual.

For if the minor were negative, the same consequences would follow which have been already pointed out in the case of a minor negative in the first figure. While a general conclusion would lead to an illicit process; as the subject, which is only taken particularly in the minor premiss, would then be universal against the fourth rule.

The principle which the third figure exemplifies may be called the *dictum de exemplo*, that is, "Two terms which contain a common part partly agree, or if the one contain a part which the other does not they partly differ;" and is generally employed to establish an objection to an opponent's premiss where his argument is such as to require that premiss to be universal. Thus, if any one contended that this or that doctrine ought not to be admitted, because it cannot be explained or comprehended, his suppressed major premiss might be refuted by the argument, that gravitation, as an occult quality, cannot be explained or comprehended: a great part of Butler's analogy might be exhibited in this form[2].

The fourth figure is only employed by an accidental awk-

[1] Against Hutcheson and others, who placed all virtue in benevolence.
[2] Whately's Logic, b. ii. ch. iii. § 5.

wardness of expression; and as the conclusion which the mind would naturally draw from premises in which the middle term appears as the predicate of the first proposition, and the subject of the second, would change it into the first figure, this course is ordinarily taken by simple conversion. Thus, in Cicero's argument[1]:

Whatever is expedient is conformable to nature,
Whatever is conformable to nature is not hurtful to society;
Therefore what is hurtful to society is never expedient.

Here the mind is naturally led to expect the converse of the conclusion to be drawn as the proper consequence, viz., "what is expedient is not hurtful to society," which would transform it into a syllogism in the first figure. It would, therefore, be only sanctioning a blunder to invest the fourth figure with axiom and rules[2], and we mention it, indeed, in this place only to caution the reader against it.

Some logicians[3], it may be observed, taking that proposition which is placed first for the major premiss; and for the minor, that which stands second, apply to the fourth figure the reasonings of the first, and condemn Aristotle for not recognising it. If, however, the major and minor premises were to be determined by their situation in the syllogism, it is obvious that the conclusion would be frequently confounded with them, since, in ordinary reasoning, it is as customary to mention the fact and then proceed to the proof, as it is to begin with the proof and then mention the fact; while in that class of reasonings which take the shape of questions and problems, it is invariably the practice to commence with a state-

[1] De Officiis, b. iii. [2] It was, notwithstanding, done by Lambert and the Port Royal logicians, though Arnauld treated the subject of his labour with some degree of contempt. See l'Art de Penser, part iii. ch. viii. Aristotle never alludes to the fourth figure; and some logicians, on the authority of Averroes (in 1 Pri. An. ch. viii. vol. i. p. 63), have attributed it, as an actual discovery, to Galen; which is much about the same as to attribute phlogiston to Beecher as a chemical discovery, because no one had stumbled upon that error before. Mr. Thompson is of opinion that Galen did not adopt the fourth figure, from the inspection of a Greek copy of Galen's Dialectia, recently published in Paris, from a MS. of the eleventh century. To prove, however, that nothing can be so absurd that will not admit even of elaborate apology, Zaberella has written a book in defence of the fourth figure. [3] Gassendi, Institutio Logica, pars tertia, canon i., and Zaberella.

ment of the conclusion[1]. Of the latter instance, we of course find many examples in mathematics; of the former, any writer will afford us frequent examples. Thus, Horace:

Qui melior servo, qui liberior sit avarus;
In triviis fixum, cum se demittit ob assem
Non video: *nam qui cupiet, metuet quoque: porro*
Qui metuens vivit, liber mihi non erit unquam[2],

which is reducible to,

He who is in continual fear is not free,
Every miser is in continual fear;
Therefore no miser is free.

The local arrangement of the propositions, therefore, which affect no change in the argument, are not to be taken as an index of the major or minor premiss, but that proposition must be considered as major, one of whose terms is the attribute of the conclusion, and that the minor, in which the subject of the conclusion is found.

§ 3.—*Moods of the Syllogism.*

The designation of the three propositions of a syllogism, in their logical order, according to their respective quantity and quality, constitutes its mood. Thus the syllogism last given, "He who is in continual fear is not free," is in the mood *e, a, e.* Since there are four kinds of propositions (*a, e, i, o*), and three propositions in each syllogism, all the possible ways in which these can be combined in a syllogism are sixty-four. For any one of these four may be the major premiss, while each of these four majors may have four different minors; and of these sixteen pair of premises each may have four different conclusions. But by bringing each mood to the test of the canon, twenty-eight will be found excluded on account of negative and particular premises; eighteen by the condition that the conclusion follow the inferior part;

[1] Sir W. Hamilton asserts, that the Greeks (Pagan and Christian, Peripatetic, Academic, Stoic, Epicurean, and Sceptic, down to the taking of Constantinople) placed first in syllogistic order the minor proposition, and that the Latins, up to the sixth century, were of accord with the Greek, when the example of Boethius caused succeeding scholars to follow the present practice, which assigns the first place to the major premiss. [2] Epist. i. 16.

six for the reason that a negative conclusion cannot follow from particular premises; and one, *i, e, o*, because the major proposition of a negative conclusion can never be a particular affirmative by the fourth rule. When these fifty-three invalid moods are subtracted from the list, there only remain eleven, viz.:

Four Affirmatives	and	Seven Negatives.
a, a, a,		*e, a, e,*
a, i, i,		*a, e, e,*
a, a, i,		*e, a, o,*
i, a, i.		*a, o, o,*
		o, a, o,
		e, i, o,
		a, e, o.

Each, however, of the valid moods are not admissible into every figure, since some may violate the general canon in one figure though not in another. Thus, *i, a, i* is a valid mood in the third figure, but in the first it would be attended with a distributed middle. So *a, e, e* would involve in the first figure an illicit process of the major, but is legitimate in the second; and *a, a, a,* which is admissible in the first figure, would in the third involve an illicit process of the minor. By a similar application of the moods to the figures in detail, it will be found that each will admit only six valid moods; and of these several, though valid, are useless, as leading to a particular conclusion when a universal might be drawn. As, for instance, *a, e, o,* in any of the four figures, or *a, a, i,* in the first figure: Thus,

All human creatures are entitled to liberty,
All slaves are human creatures;
Therefore *some* slaves are entitled to liberty.

For this reason, five out of the twenty-four moods arising out of the union of six valid moods in each figure are rejected; so that nineteen remain as the only valid forms in which inference can lead to a useful result; and even of these, five may be very well neglected as belonging to the fourth figure. As one mood may occur in two figures, it is necessary to distinguish both the mood itself and the figure in which it is to be found, and to effect this purpose logicians have devised names, with vowels, corresponding to the several

moods, and arranged them in verses, each line of which answers to the respective figure in which the moods occur. Thus:

FIG. 1. B*a*rb*a*r*a*[1], c*e*l*a*r*e*nt, d*a*r*ii*, f*e*r*io*que prioris.
FIG. 2. C*e*s*a*r*e*, c*a*m*e*s-tr*e*s, f*e*st*i*n*o*, b*a*r*o*k*o* secundæ.
FIG. 3. Tertia, d*a*r*a*pt*i*, d*i*s*a*m*i*s, d*a*t*i*s*i*, f*e*l*a*pt*o*n
B*o*r*a*rd*o*, f*e*r*i*s*o*, habet. Quarta insuper addit
FIG. 4. Br*a*m*a*nt*i*p, c*a*m*e*n*e*s, d*i*m*a*r*i*s, f*e*s*a*p*o*, fr*e*s*i*s*o*n.

The five moods of the fourth figure are sometimes expressed as

B*a*r*a*l*i*pton, c*e*l*a*nt*e*s, dabitis, f*a*p*e*sm*o*,
Fr*i*s*e*s*o*morum,

which transform the minor into the major premiss: For it was maintained, as Aristotle had not made a separate figure for these moods, that they were only indirect moods of the first figure with the conclusion reversed, and that, consequently, the attribute of the latter was the true subject. But as the conclusion is invariably supposed to be the thing which requires proof, it is certainly preferable to take always as the major the proposition into which the attribute of the conclusion enters, and bring them under the first figure by simple conversion.

§ 4.—*The Quantification of the Predicate (new analytic) considered with reference to Mood and Figure.*

The list of valid moods has been enlarged by introducing into the combination the four additional propositions which emerge out of the express quantification of the predicate: but as we endeavoured to show that judgments with a quantified predicate were never practically subject to the mind's attention, and that if it needed to express the relations about which they are employed, it would fling them

[1] These verses commence (*barbara*) ominously enough, and have been the subject of some wit and banter. It must, however, be confessed, considering the age in which they were produced (thirteenth century), and the man in whose works they were first found (Peter Hispanus), that they display an ingenuity which might have excited the envy of the Stagyrite himself. In addition to the distinction of mood and figure, the consonants, combined with the vowels, were intended to serve a distinct purpose in reduction, which, however, the discovery of *dicta* quite as potent as the axiom *de omni et nullo* for each of the figures, has rendered nugatory.

into one of the forms included in the four judgments, *a*, *i*, *e*, *o*, to which we have restricted the consideration of logical quantity and quality, we might rest the matter here: since if that position be sound, the extension of valid moods can only be gained by the interpolation of useless propositions, leading to conclusions or inferences that no one ever seeks to establish. It may, however, be important, considering the high quarter[1] from which the doctrine of the complete quantification of the predicate emanates, to give it an ampler consideration here, where it is designed to replace the old category of syllogisms, and which, consequently, is alleged to be the true sphere of its utility.

The two great ends which the new quantification is designed to accomplish, are the amplification of the valid forms of reasoning, and through it, the abolition or simplification of all that is cumbrous in the old system of logic. The first of these is certainly effected by the introduction of the four additional propositions, *v*, *y*, *x*, *z*, already given[2]; as these would increase the list of judgments to eight; and the different modes of combining eight propositions by three (the number which constitute the syllogism) would be 8×8 $(= 64) \times 8 = 512$. After the invalid syllogisms have been excluded from this large category, there remain thirty-six legitimate syllogisms—twelve negative and twenty-four affirmative—for each figure, so that if we even restrict ourselves to the three first figures we shall get 108 forms of valid inference in lieu of the twenty-four obtained in the old table.

On examining the new forms of judgment, however, the majority of the inferences will be found so weak and indefinite as to be of no practicable utility; while there is hardly one of those which may be said to add something to our knowledge of the subject, which the mind would not throw into one of the first four propositions as a more natural expression of the relation between the subject and the predicate than the constrained forms sought to be introduced. Thus, to take the first case, of what earthly use is it to infer by the mood *o*, *i*, *z* (of the second figure), the following:

Some minerals are non-conductors,
Some metals are conductors;
Therefore some minerals are not some metals;

1 We need hardly say the distinguished professor of logic and metaphysics in the University of Edinburgh, Sir W. Hamilton.
2 *Ante*, p. 93.

notwithstanding every mood in which x, z occur, that is forty-five out of the 108, end in some intimation of an equally startling character.

Though the syllogisms in which y occurs alone, or in combination with any of the four propositions a, e, i, o, are competent to communicate information which might fairly form the subject of inference; yet this is done in so unnatural a manner that the mind, even in its most confused state, never stumbles upon them by the remotest accident. Thus, who could ever be led to infer y, y, y, in the first figure?

> Some beasts are all cloven-footed,
> But some animals are all beasts,
> Therefore some animals are all cloven-footed.

Yet this is an average specimen of the class of syllogisms the reader would get from introducing y into the series of propositions. It is obvious, as we have before remarked, that if the mind had to express such a relation it would transfer the terms thus:

> All cloven-footed creatures are beasts,
> But all beasts are animals,
> Therefore all cloven-footed creatures are animals,

which would bring the syllogism into the mood a, a, a. On account, therefore, of that mental law which leads us invariably to affirm the particular of the universal, and consequently to assign to the latter the first place, or, in other words, to make it the subject of the judgment, the proposition y may be regarded as deformed and useless in logic: its place is always naturally supplied by a.

The moods in which u occurs, though not so faulty in expression, may be put out of court for the same reasons as y, its functions being so completely discharged by a, that no instance can be adduced of a practicable nature which would call for its interposition. Thus, to take a casual instance, in u, a, a, of the second figure:

> All responsible agents are all men,
> But all Ethiopians are men,
> Therefore all Ethiopians are responsible agents;

we do not require the attribute of the major to be taken universally to get the conclusion, which would be equally evident were the more natural judgment (a), viz., "All

responsible agents are men" substituted in its place. The mind, indeed, never adverts to the extension of the predicate further than is required to ascertain whether it can be affirmed or denied of the subject; the consideration how far it may overlap it, or to what other things it may be applied, would be quite extraneous to the judgment before it, and is therefore never dwelt upon. Admitting, therefore, the extension of the valid forms of reasoning at which the doctrine of quantification aims, a close inspection of the new judgments which arise from its application compels us to reject it as useless; for where the inference to which they lead is not equivocal or ambiguous, it is too awkward to be ever used; and, in the latter case, the relations of the judgment, and the subsequent inference, find their natural expression in the nineteen moods already given.

Nor is the plea of utility unadmitted by the advocates of the new system, who advocate many changes on that ground, although they involve themselves in not a little inconsistency by challenging at the same time for logic the evolution of all the conceivable modes of thought. That the two principles are often in antagonism, no one can deny, since many modes of inference are conceivable which have no practicable utility; and least of all the proposers of the new quantification, who reject the fourth figure on the very ground that we extrude the new analytic from a practical system of logic[1], viz., that of its utility; but as they have admitted the competency of that test to sweep away a figure along with its five moods, they cannot shield themselves from its application to the new table of judgments, which it will be found to explode quite as effectually as the fourth figure. But we are disposed to carry the test of utility to higher ground, and apply it to the very extension of reasoning forms, which it is the professed mission of the new analytic to establish. Is it really conducive to those functions which logic was created to discharge, that the forms of valid reasonings should be multiplied? We think otherwise. The aim of logical science is simply to teach men to reason legitimately, and to place in their hands a body of rules by which sophisms may be detected; and the fewer the forms to which all correct and habitual inference may be reduced,—the more compact the moods in which all legitimate reasoning can be represented, the better and sooner

[1] See Mr. Baynes'sNew Analytic.

will this object be effected. To scatter the nineteen legitimate forms of inference over 108 distinct moods, comprising the conceivable as well as the actual forms of reasoning, is only breaking down the fence which enables us to hunt a sophism into a corner, and by multiplying the valid tests to which any argument can be brought—to multiply, besides the additional labour, our chance of error in the application of them. The aim of the new analytic, therefore, in enlarging the field of inference, is hardly fortunate; in a practical sense it does not succeed, and even if it accomplished its object success would be worse than defeat; for it would be accompanied by the destruction of the very simplification which render the doctrine of the syllogism really serviceable to the reasoner.

It is, notwithstanding, one of the professed aims of the new analytic to simplify logic, and that through the very means by which its lists of valid judgments would be rendered more complex; and it is supposed to effect this object in three ways: viz., by reducing the general rules to one complete canon; by the abolition of the special rules of the figures; and by the removal of the erroneous doctrine of conversion of propositions and reduction of syllogisms[1]. The first and second notion we need hardly say are simply absurd, inasmuch as the general rules, and even the special rules of the figures, are in nowise distinct from the canon, but only act as so many cautions, which it is advisable for the reasoner to have before him, in order that he may not violate any of its principles. They might, therefore, be omitted from the old logic with as much propriety as from the system sought to be established, and with more security against error, since its code of valid syllogisms are much fewer than those arising out of the quantification of the predicate, and consequently afford less ground for the violation of the canon. But in reality they can be spared in neither system, as it is obviously necessary, to secure the understanding from error, that every mode by which a deviation can occur from the principles of right reason should be drawn out distinctly before it. The Ten Commandments are reduced by theologians to two; but it would hardly conduce to the fulfilment of the natural law to insist on that account upon their abolition.

With regard to the cranky doctrine of reduction, it does

[1] Mr. Baynes's New Analytic.

not require the introduction of the new analytic to escape from its intricacies, as the legitimation of each figure by its own axiom renders that doctrine not only nugatory, but absurd. It has been, consequently, avoided by many logicians, from the days of Wolf downwards, who never dreamt of quantification; and we have omitted it in this logic on similar grounds. As respects conversion, we in the last book have shown the object which it is intended to effect is indispensable to many forms of solid argument, and presents a lever of proof which could not be supplied by the quantification of the predicate; its abrogation, therefore, would only weaken the science by depriving it of one of the means of producing conviction.

The introduction of the new analytic, therefore, can serve no purpose of simplification beyond that already attained, while it would materially enhance the danger of error by enlarging the list of valid moods in each figure, to which the rules would have to be applied, and in some measure introduce the complexity into logic it was designed to abolish. We consequently reject it on three distinct counts; because a part of the object at which it aims is chimerical; because it fails to accomplish the remaining part; and thirdly, because that portion of the object, even if achieved, would be destructive of the very simplification it is instituted to realise[1].

CHAPTER II.

NOTATION OF THE SYLLOGISM.

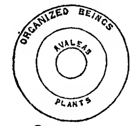
§ 1.—*Euler's Method.*

THE relations which mentally subsist between conceptions have been attempted to be represented to the eye by diagrams, and though some mathematical logicians have carried

[1] It would exceed our limits to answer the particular charges which Sir W. Hamilton, through the medium of his pupil's essay, brings against the old doctrine of mood and figure; such as that of inconsistency in the discrimination of mood where there is no difference of quantity and quality, but a mere transposition of terms; and that of mere accidents of expression prevailing over essential forms of thought, in rendering moods valid in one figure, invalid in another. Every one of these allegations admit of a satisfactory reply, which we reserve, however, for another place.

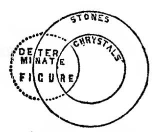
this species of notation too far[1], it must be allowed, if kept within moderate bounds, to facilitate logical analysis.

The most celebrated scheme, and at the same time the simplest, is that of Euler[2], which represents the sphere of a conception by a circle; an affirmative judgment by one circle, wholly or partly contained in another; and a negative by two separate circles. Thus, since the proposition "all plants are organised beings," includes under organised beings many species of plant, the former term is represented by a large circle, and the latter by a small one enclosed within it. If we, consequently, include "avaleas" in the class "plant," this term will fall into a smaller circle than plant, and be enclosed by it in return. We shall thus get the diagram:



as illustrative of the mood *a, a, a,* of course in the first figure, in which it can only occur.

Again, were we to infer that "some stones have determined figures," from the fact that "all crystals have determinate figures," and some stones are crystals, the scheme may obviously be represented by making the circle which denotes crystals cut the circles denoting stones and determinate figures. Thus:



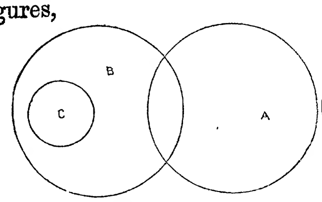
This constitutes *a, i, i,* of the first figure. The mood *e, i, o* of the same figure is represented in a simpler form. Thus, supposing it required to prove some men are not responsible agents, our argument would naturally be:

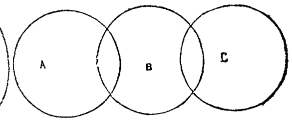
[1] Ploucquet, one of the first to introduce it, appears to labour under this error with Condillac. Prof. de Morgan, in his excellent treatise on Formal Logic, may be said, to use a phrase of Bacon's, "to corrupt logic by mathematics." What end can it serve to invest logical relations with the forms of the calculus, and to be constantly carrying analogies below zero, and considering them under some relation of infinitude?

[2] Lettres à une Princesse d'Allemagne, vol. ii. p. 110, and continuation.

None who have lost their reason are responsible;
But some men (lunatics) have lost their reason;
Therefore, some men are not responsible.

Assuming *A* for the middle term, *B* for the attribute of the conclusion, and *C* for the subject, we get either of the two figures,

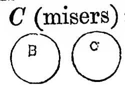


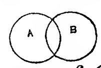


For it is not necessary to know how far *C* may be included in *B* to infer the conclusion; it may, in fact, either be identical with it, or wholly included in it, or only in part.

In addition to the transparent clearness with which this notation serves to bring out the relative extension of the terms of a syllogism, it occasionally is useful in showing the falsity of an argument, hardly perceptible when conveyed in ordinary language, as,

Some learned men are misers,
No miser is virtuous;
Therefore some virtuous men are not learned.

Representing the major, minor, and middle by the letters *A*, *B*, *C*, it is evident that no part of *B* (virtuous men) is included in *C* (misers): their spheres, consequently, are quite separate 

. But because some of the class *A* is included in *B*, that is 

, we are not on that account entitled to say that part of *C* is not *A*, as for anything we know it may be included in the whole of it. The only legitimate inference it is competent to us to draw in this case is, *that part of A which is included in B is not C.*

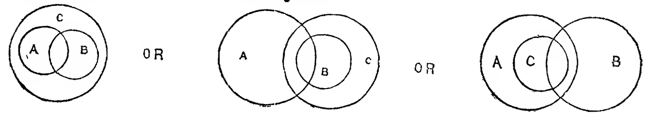
Again, suppose it required to notify

Some *A* is *B*;		Some *A* is *B*;
All *B* is *C*;	or,	All *A* is *C*;
Therefore some *C* is *A*;		Therefore some *C* is *B*;

or its negative:

Some A is not B:
All A is C;
Therefore some C is not B;

the figures would evidently be:



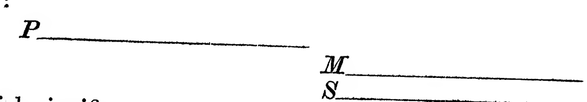
§ 2.—*Ploucquet and Lambert's Method.*

The method which Ploucquet introduced and Lambert perfected, is more definite than Euler's, and consequently of much easier application. It serves, also, to bring out many inferences which Euler's notation hardly suggests, from substituting for the sphere of a term the more logical idea of its distribution. Thus a distributed term is denoted by an horizontal line ————, with the letter S, P, or M, attached according as it is the subject, predicate, or middle term of the syllogism: while an undistributed term is marked by a row of dots . . . . in a line with its significant letter.

Now premising that every affirmative judgment is represented by drawing one line under the other, the predicate being always uppermost; and every negative by drawing the two lines apart, we may represent the argument adduced by Dryden in defence of Christianity[1]:

No body of impostors would have conspired to cheat men with a lie without temporal gain;
The Apostles did this;
Therefore they were not impostors.

As:



which signifies

No M is P;
But all S is M;
Therefore no S is P.

[1] Hind and Panther.

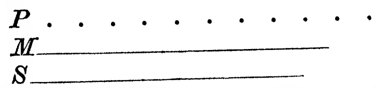
Again:

All organised beings without volition are endued with unconscious perceptions;

But plants are organised beings;

They are therefore endued with unconscious perceptions;

would become,



From this notation, besides the two premises given,

(1) All M is P,
(2) All S is M,

we may infer

(3) Some P is M,
(4) Some M is S.

§ 3.—*Sir W. Hamilton's Method.*

The notation of Sir W. Hamilton surpasses all its predecessors in its completeness and simplicity, and were it not exclusively framed to meet the extensive changes which the introduction of the new analytic would introduce into logic, its practical value would be inappreciable. The former systems of notation only embrace the extension of a syllogism, this includes its intension, besides denoting the premises which may be converted without changing the mood of the figure. To give the entire method would be useless, as we have not adopted the system to which it corresponds. Its outlines, however, are well worthy of inspection, as a specimen of learned ingenuity.

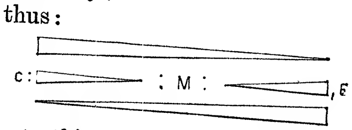
The middle term is invariably represented by its initial letter M, while C and F stand for the two terms of the conclusion; a colon (:) denotes the distribution of the term to which it is annexed; a comma (,) signifies it is not distributed. When the middle term consequently has (:) on one side, and (,) on the other, its extension is determined by the term with which either of those marks is associated in judgment. The agreement of two terms is signified by ▬ and disagreement by ⇸, the thick end of the bar denoting the subject, the thin end the predicate when we regard the extension of the terms; but contrariwise when the syllogism

is interpreted according to its intension. Thus, in the one case, C: , M would denote "all C is some M," in the other, "all M is some C."

The terms are generally stated in the same line with a bar drawn beneath them to indicate the conclusion; but as in the second and third figures there may be two conclusions indifferently, a second bar is drawn above the terms to express the second of them. Thus, Oersted's argument:

> All cases of magnetic polarity are cases of opposite properties in opposite directions;
> But some electric phenomena, viz.—the voltaic pile and electrified minerals, develope opposite properties in opposite directions;
> Therefore some electric phenomena are all cases of magnetic polarity;

would figure thus:



For, according to this system, it is of little moment whether we infer from the premises,

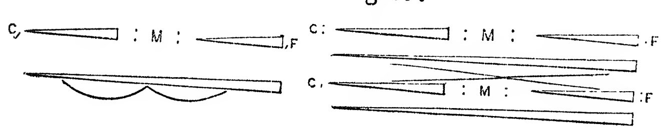
> Some electrical phenomena are all cases of magnetic polarity,

or,

> All cases of magnetic polarity are some electrical phenomena,

as its author will allow no distinction between major and minor premiss.

We may add, the mark placed under a mood denotes that the premises may be converted without affecting either the quantity or quality. But the sign between two moods signifies that this transposition of the premises cannot occur without the two corresponding syllogisms changing places with each other. This may be easily perceived, without further explanation, from the adjoining diagram of syllogisms in the first figure:



§ 4.—*Use of Notation; Equivalent Syllogisms.*

The chief end of any adequate system of notation is to present to the eye, by a species of symbolical language, all the intricate relations which subsist between terms in a syllogism, so that no point may be overlooked which has any bearing on the conclusion, and the inference be viewed in all the various shapes which the premises allow it to assume. It is not only serviceable in simply illustrating the rules of syllogisms, though that utility is sufficiently great to challenge its admission into every logical system; but it can, moreover, be employed, by way of a "glaring instance," to test the validity of an argument when the application of the canon to its syllogistic form has been attended with a doubtful result.

Another great advantage attending notation is, that, if properly developed, it must not only represent the mutual relations of terms, but to some extent of propositions and syllogisms. It is in many cases very desirable to know what premises can be converted without changing the mood of the syllogism, *i. e.* without interfering with the quantity and quality of each proposition in it; what syllogisms in each figure will pass into one another's place on the transposition of the premises; and also in how many figures the same argument may be stated; so that if its cogency be denied in one, it may be presented in another.

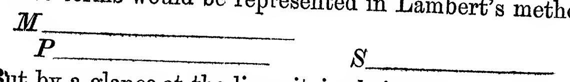
It is obvious, though neither judgment or inference may derive more intrinsic light or force from one mode of statement more than another, that there are certain forms in which an argument will strike conviction to some minds; which, if presented in another though equally conclusive shape, it would have failed to effect; and it becomes, therefore, of moment to the logician to be familiar with all the modes in which a valid syllogism can be urged, in order that when conviction does not attend his reasonings in one form, he may produce them in another. All the artifices, indeed, of mood, conversion, and figure, comprise only a species of symbolical representation, with a view to show the various ways in which the relation between the terms of an argument can be expressed while that relation remains fixed and immutable.

With a view to exhibit the utility of this species of cipher

as far as equivalent syllogisms are concerned, let it be required to be shown in how many ways the following argument may be proved:

> Electricity will travel along a tied nerve,
> The nervous fluid will not travel along a tied nerve;
> Therefore the nervous fluid is not electricity.

This is a syllogism in Camestres, and the permanent relation of the terms would be represented in Lambert's method by



But by a glance at the lines it is obvious we can express the same argument quite as conclusively in Cesare. Thus:

> The nervous fluid will not travel along a tied nerve,
> Electricity will travel along a tied nerve;
> Therefore electricity is not the electric fluid;

or instead of asserting that no part of *S* agrees with *M*, we may express the converse, which will lead to a syllogism in Celarent of the first figure:

> Nothing that travels along a tied nerve can be the electric fluid,
> Electricity travels along a tied nerve;
> Therefore electricity cannot be the nervous fluid.

In this manner notation is pre-eminently useful in suggesting all the inferences which may be drawn from the syllogistic relation of terms, thus leaving the logician at liberty to choose that which best suits his purpose, either in the establishment or demonstration of fact, or in producing conviction in the mind of others.

CHAPTER III.

KINDS OF SYLLOGISMS.

§ 1.—*Complex Syllogisms.*

Every form of argument yet considered has been of a simple incomplex character, with a view to place the nature of the syllogism in as clear a light as possible, that there might be no difficulty in comprehending the full import of its various properties, and the bearings of the rules which

All philosophers maintain[1] that heavy things fall to the ground without being impelled by anything;
But this is an error;
Therefore all philosophers may teach error.

Here the first part of the minor is the subject, for we affirm of philosophers that they teach a certain doctrine: but should we argue,

All philosophers maintain that heavy things fall to the ground without being impelled by anything;
But stones are heavy;
Therefore stones fall to the ground without being impelled by anything,

the minor, or complex proposition, would become the major, and that part of it which was the subject before, would become an incidental proposition, merely qualifying the attribute and having no bearing on the inference. Thus:

Heavy things fall to the ground without being impelled by anything (according to the teaching of philosophers);
But stones are heavy;
Therefore stones fall to the ground without being impelled by anything (according to the teaching of philosophers).

It is therefore necessary, before eliminating from the terms of the syllogism such words as are only incidental, to know distinctly what is aimed at by the proof; as part of a proposition may be a term in one sense, and only an incidental expression qualifying a term in another[2].

Some logicians[3] desirous to find a shorter process to the validity of such syllogisms than their reduction to incomplex forms and the application of the general rules afford, have placed the entire artifice of reasoning in showing that the conclusion is contained in one of the first propositions by the interpolation of another, which establishes the inclusion; and since no argument can be vicious which is true to this principle, they are disposed to accept it as an easy test by which, without reference to mood and figure, the correctness of every syllogism, however complex, may be ascertained.

[1] As was the case anterior to the time of Galileo. [2] See *ante*, pp. 79 and 90. [3] Arnauld and Nicol. See l'Art de Penser, part iii. ch. ii.

Thus, on being required to show that every vicious man is unhappy, we first endeavour to find a more evident proposition in which this is implicitly contained, as, Every man who is the slave of his passions is unhappy (containing proposition); but as this does not include the judgment which is sought to be established expressly, we interpolate another proposition to show that the containing proposition undeniably includes what we desire to prove, as, Every vicious man is the slave of his passions (applicative proposition). The syllogism would consequently be:

Every one who is the slave of his passions is unhappy,
Every vicious man is the slave of his passions;
Therefore every vicious man is unhappy.

In affirmative syllogisms it is frequently optional which premiss is assumed to be the containing or applicative proposition, as each will contain the conclusion in such case, only in a different sphere, the major in that of extension, the minor in the counter one of comprehension. Thus, in the above example, the subject of the conclusion, "vicious," is contained under the extension of the subject of the major, "slave of his passions," and the minor shows this. But the minor contains it likewise, since "slave of his passions" comprehends in its idea that of "unhappy," as the major indicates. As the major, however, is nearly always the more general proposition, it may be commonly regarded as the containing proposition, and the minor only the applicative.

In negative syllogisms the affirmative proposition, whether major or minor, will be the least general, and consequently will form exclusively the applicative proposition, as in the argument:

Every happy man is content,
No miser is content;
Therefore no miser is happy.

It is more natural to say that the minor contains the conclusion, and that the major, which is affirmative, proves the inclusion, than contrariwise. For the minor separating miser from content, excludes it also from the term happy, since that attribute, according to the major, is wholly contained under the extension of content.

§ 2.—*Conditional Syllogisms.*

There are other kinds of syllogisms corresponding to the different forms which the major proposition may assume, and as this gives the name to the syllogism of which it forms a part, the latter may be said to admit in some sort of the same multiform division as propositions themselves. We have already dealt with that class of them which are simple, incomplex, and complex, we proceed now to deal with compound syllogisms, and take, as the first in order, that species which is termed conditional.

These may be defined to be syllogisms in which the major is a conditional proposition containing the entire conclusion. For example:

> If matter cannot move of itself, its first motion must have been given to it by a spiritual being;
> But matter cannot move of itself;
> Therefore its first movement must have been given to it by a spiritual being.

Since the consequent may be inferred from the concession of the antecedent, and the denial of the antecedent from the negation of the consequent[1], we get two corresponding kinds of conditional syllogisms; the affirmative being called constructive, the negative destructive. For instance, in the proposition, "If the crops are bad, corn must be dear;" should the antecedent be conceded, the first case applies, and the consequent may be inferred. The argument would consequently be:

> If the crops are bad, corn must be dear;
> But the crops are bad;
> Therefore corn is dear.

This conditional is constructive. But if the consequent is denied the second case applies, and the syllogism emerges in a destructive form. Thus:

> If any increase of population is desirable, some misery is desirable:
> But no misery is desirable;
> Therefore some increase of population is not desirable.

Hence conditional syllogisms, in addition to being faulty as to matter when the condition is irrational, can with respect

[1] See *ante*, p. 83.

to form be defective in two ways, viz., when we attempt to infer anything from the affirmation of the consequent, or the denial of the antecedent. For it is obvious from the concession of the consequent we can infer nothing, since the same consequent may follow from other antecedents; as in the above example, corn may be dear from other causes besides a failure in the harvest. Therefore it does not follow from corn being dear that the harvest has failed. In like manner we cannot infer from the denial of the antecedent, viz., that the crops are not bad, that they are not dear.

Yet arguments in which the latter fallacies are used, are occasionally made to assume a very plausible shape: thus,

If such an administration had involved the country in war, it would have been a bad administration;
But it did not involve the country in war;
Therefore it was not a bad administration.

Or,

If I refused to meet my liabilities, I should be a bad member of society;
But I do not refuse to meet my liabilities;
Therefore I am not a bad member of society.

These we need not say are arguments which prove nothing, since a bad member of society and mal-administration may arise from various other sources besides those assigned. When, however, there is an exclusion, either understood or expressed in the major, no objection can be taken to this kind of inference. As in Cicero's defence of Muræna:

"I could then *only* be accused with justice of acting contrary to my law, if I maintained that Muræna purchased the votes, and was justified in doing so. But I maintain that he did not buy the votes, therefore I do nothing contrary to the law[1]."

The same may be said of the argument urged in the following passage of the Æneid:

"Si sine pace tua, atque invito numine Troës
Italiam petiere, luant pecata, neque illos
Jûveris auxilio. Sin tot responsa secuti,
Quæ superi manesque dabant; cur nunc tua quisquam
Vertere jussa potest? aut cur nova condere fata[2]?"

[1] Orat. pro L. Muræna, c. iii. Ramus cites it as an example of bad reasoning, but he is evidently in error. [2] Æneid, x. 31.

For, supplying the exclusive term in the major, the reasoning may be thus rendered:

If the Trojans had come into Italy contrary to the will of the gods, they would then alone have been punishable;
But they came not contrary to the will of the gods;
Therefore they are not punishable.

If the exclusive term, however, could not be established, the argument would be nugatory. These syllogisms may be changed into a categorical, by the reduction of the major to that form.

§ 3.—*Disjunctive Syllogisms.*

Those syllogisms are disjunctive whose major contains a disjunctive proposition[1]; whose object is to state an alternate which leaves us at liberty, either by denying one part to infer the other; or, by affirming one part to reject the remaining. Of the first kind, Cicero's argument may be taken as an example:

Those who have slain Cæsar, are either parricides or defenders of liberty;
They are not parricides;
Therefore they are defenders of liberty.

But it is not necessary that the alternative should be restricted to two terms; it may lie between several, as:

All sciences are either pure, inductive or mixed sciences;
But astronomy is not a pure, or an inductive science;
It is therefore a mixed science.

Gibbon's argument may serve as an instance of the second:

Mahomet was either an enthusiast or an impostor;
But he was an enthusiast:
Therefore he was not an impostor.

Disjunctives are rarely defective, unless through the weakness of the alternative which leaves a mean between the opposed members. This, indeed, occurs in the last syllogism, for there is nothing so antagonistic in the nature of an enthusiast and impostor as to prevent them being combined in the same person, even at the same time, as was undoubtedly the case with Mahomet. Of course when both members of the major are true, we are not authorised, from the denial or affirmation of the one to infer anything with regard to the other, but only when the members are exclusive.

[1] See *ante*, p. 82.

§ 4.—*Copulative Syllogisms.*

These syllogisms are only another form of disjunctives, with the alternative expressed in the major by the copulative conjunction "at the same time," "and," instead of "*either*," "or." For example:

A Government cannot be at the same time despotic and the licenser of a free press;
But the English Government permits a free press;
Therefore the English Government is not despotic.

Now, granting the truth of the matter in the above syllogism[1], it is evident we can only from the concession of one part deny the other; but cannot conclude anything from the denial of one part. Otherwise we might argue,

A Government cannot be at the same time despotic and the licenser of a free press;
But the English Government is not the licenser of a free press;
Therefore the English Government is despotic;

which of course would be absurd, since despotism may arise from a variety of other circumstances besides the violation of freedom of discussion, and because matters may occasionally take such a course as to warrant the present Government to place restrictions on the press, with a view to preserve, even liberty.

§ 5.—*The Dilemma.*

A syllogism with a conditional major, in which either the antecedent or the consequent is disjunctive, is called a dilemma. Thus, the argument of divines against temporal felicity may be expressed in this form:

Man can only be truly happy on earth by yielding to his passions, or by combating them;
But either of these courses is attended with pain;
Man cannot therefore on earth be truly happy.

Neither antecedent or consequent, however, is restricted to a double member, as the word dilemma implies[2], but either, or

[1] Which some (Mr. Disraeli) are disposed to contest. [2] The word literally signifies, "double proposition;" hence the common expression of the "two horns of a dilemma." But the popular meaning of the term arises from the condition of some one of the antecedents being true, or one of the consequents false, though we cannot say which is so.

even both, may be compound to any degree, as in the argument of St. Augustine:

If children suffer misery, it must be either—1st. As the consequence of sin committed in a previous life[1]. Or, 2nd. The impotence of God, who has not the power to prevent it. Or, 3rd. The injustice of God, who inflicts it without a cause. Or, 4th. Original sin;
But it is impious to allege the three first causes;
Therefore the misery of children is to be attributed to original sin.

Or, if the major premiss have a compound antecedent with a simple consequent, the latter may be affirmed of any one member of the antecedent disjunctively granted. As:

Whether the soul perish with the body, or survive it in the same or another form, death is to be feared;
But either of these cases will happen;
Therefore death is to be feared.

But should the different members of the antecedent have each its separate consequent, then each member of the antecedent being as before disjunctively granted, the consequent can be only disjunctively inferred. For example:

If Æschines joined in the public rejoicings he is inconsistent; if he did not he is unpatriotic. But he either joined or not; therefore he is either unpatriotic or inconsistent[2].

The forms already given, which end in affirmative inference, are generally termed constructive; there are, however, others of a negative kind, in which, having denied the whole of the consequent, or consequents, we deny the corresponding antecedent. These are termed destructive. Thus:

If despotic Governments are conducive to the welfare of society; then the restriction of individual rights, the publication of arbitrary enactments, and the restraint of public opinion is beneficial;
But none of these are beneficial;
Therefore despotic Governments are not conducive to the welfare of society.

[1] A belief of some Pagan philosopher.

[2] The argument of Demosthenes in the De Corona.

There are many dilemmas in which the proposition containing the alternative is understood, being sufficiently indicated by the statement of each particular part of which it consists. Thus, the argument urged by Antisthenes, that we ought not to meddle with the affairs of the State, which seems to have had great influence upon some of the ancient philosophers:

If we conduct the affairs of State well, we shall offend men;
If we conduct them ill, we shall offend the gods;
Therefore it is not expedient to engage in them.

Of the same kind is the argument of Bias, quoted by Aulus Gellius, in defence of the bachelorate:

If a wife is beautiful, she excites jealousy (ἕξεις ποινήν);
If she be ordinary, she disgusts (ἕξεις κοινήν);
Therefore it is best not to marry.

In such cases the omitted proposition should be supplied before the force of the dilemma is tested, as it may entirely invalidate the conclusiveness of its matter. Thus, the dilemma of Antisthenes, when fully expressed, would require as its major:

"It is not expedient to engage in State affairs, if we either displease god or men;"

a proposition which bears the falsity of its matter on the face of it. Pursuing the same course, the universal proposition to the dilemma of Bias would be:

It is not wise to marry, if a woman creates jealousy or disgust;

a proposition which, even if admitted, would not establish the conclusion, since many beautiful women so comport themselves as to leave no room for jealousy; and many ordinary ones possess qualities of mind which cannot fail to please all who approach them. Hence it is obvious, with regard to the matter of dilemmas, that each particular conclusion should be necessary, and that the dividing member should comprehend the entire subject to which they appertain.

As dilemmas belong to the class of compound conditionals, they are reducible to two or three simple syllogisms of that

kind, and the validity of their form may be tested by the same rules. Thus, the dilemma: "If a man be wicked or insane, he is unfit for society; a criminal is either of these two; for if he knew the consequences of his act he was wicked; if he did not he was insane; therefore he is unfit for society;" may be resolved into two simple conditional syllogisms, in which "wicked" will form the attribute of one minor premiss, and "insane" of the other. Dilemmas consequently admit of being stated like pure conditionals, in a categorical form. As:

The case of *A* being *B*, is a case of *C* being *D*, or *E* being *F*;
This is not a case of *C* being *D*, or *E* being *F*;
Therefore it is not a case of *A* being *B*.

In the same manner constructive dilemmas may be reduced to categoricals, and, if needs be, tested by the general rules of the canon.

§ 6.—*The Chain Syllogism, or Sorites.*

When a series of inferences occur in such order as to make the predicate of one proposition the subject of the next, till the attribute of the last of the premises is predicated in the concluding proposition of the subject of the first, we have what is termed a sorites[1]. Thus: *A* is *B*, *C* is *D*, *D* is *E*, therefore *A* is *E*, where the mind passes from proposition to proposition, without expressing the conclusion until it reaches the attribute which it seeks to connect with the subject of the first proposition. Of this kind of argument we cannot adopt a better illustration than one given by Lord Eldon, on the occasion of Laurence's injunction concerning the pirated edition of his book on the Natural History of Man: "I have a rational doubt whether some portion of this book do not lean to materialism; what leans to materialism is inconsistent with the immortality of the soul; what is inconsistent with the immortality of the soul is contrary to Scripture; but as that which contradicts Scripture does not come under the protection of the law, I have a rational doubt

[1] Or, accumulating argument, from the Greek σωρὸς, a heap, though we must confess the German name *Kettenschluss*, which we have adopted, is more significant.

whether the injunction can be maintained; therefore the injunction is dissolved[1]."

It will be observed that each intermediate proposition between the first and last contains a middle term of the sorites, which, on that account, is capable of being drawn out into as many distinct syllogisms. In the major of the first syllogism, the second proposition of the sorites must be taken, while the first proposition will form the minor premiss, and to each succeeding syllogism, the conclusion of its predecessor will form the second premiss. Hence the first proposition in the sorites is the only minor premiss which is expressed. From this we may conclude that the first proposition alone of all the premises can be particular; because in the first figure into which the reasoning of the sorites falls, the minor may be particular but not the major: and all the other propositions anterior to the conclusion are major premises. It may likewise be inferred that in a sorites there can be but one negative premiss, and that the last; for none other could be negative without involving, contrary to the rule of the first figure, the implied syllogism in a negative minor.

A sorites may be exhibited in two ways by reversing the order of the premises in the examples already given. Thus, *D* is *E*, *C* is *D*, *B* is *C*, *A* is *B*, therefore *A* is *E*. In this form, which is called the Goclenien, from the name of its originator, extension is more conspicuous, as the sorites starts from its two widest terms, while in the common form intension predominates. The former descends in extension from the predicate to the conclusion; the latter ascends in intension from the subject[2].

It may be remarked that a chain of conditional syllogisms may be expressed in either of these forms. Thus, if education be indispensable to the progressive development of society, it is important that it should be well conducted. If it is important it should be well conducted, an order of men should be strictly trained for that purpose under the surveillance of the State. But education is essential, &c., therefore an order of men should be strictly trained, &c. Of course if the sorites were destructive, the procedure would assume the Goclenien form, and we must go back from the

[1] Campbell's Lives of the Chancellors. [2] Thompson's Laws of Thought, p. 284, 2nd ed.

denial of the last consequent to the denial of the first antecedent.

§ 6.—*Of the Enthymeme, or Imperfect Syllogism.*

It is usual for logicians to denote one or two abridged forms of arguments, commonly called enthymemes and prosyllogisms; though as these distinctions only arise from accidental forms of expression, there is no reason for their admission into logic, any more than a score of others of the same kind which might be mentioned. The enthymeme is usually called a syllogism with one premiss suppressed; but as all the terms are comprised in the conclusion and the expressed premiss, the one omitted is commonly understood, and may be readily supplied. Thus, Victoria is a sovereign who respects the forms of the constitution, therefore her subjects are free: the major premiss wanting to make the syllogism conclusive from the form of expression is, the subjects of every sovereign who respects the forms of the constitution are free; but this is so easily understood as to be dispensed with in the ordinary usage of language.

When one of the premises of a syllogism is itself an enthymeme, the concluding clause of that premiss is termed a pro-syllogism, as the bracketed line in the argument:

Everything which concerns the public weal ought to be under the control of the Legislature;
But education is such (since property cannot be secure without it);
Therefore education ought to be under the control of the Legislature.

Sometimes the conclusion of the syllogism in common parlance furnishes a species of premiss from which a second conclusion is deduced, in which case the last proposition is termed an episyllogism: A statesman who involved the country in great debts could not be a good financier; Pitt involved the country in great debts, therefore he was a bad financier, and (therefore he is unworthy of indiscriminate panegyric).

BOOK IV.

GENERAL PRINCIPLES OF INFERENCE.

PROEMIUM.

WHEN the truth of either premiss, or both, in a syllogism is not intuitively evident, other arguments are required to establish its validity, which gives rise to what are called trains of reasoning, or combinations of inference. An example of this kind has already been furnished in the sorites, which is nothing else than a series of syllogisms stript of the minor which is easily understood, and so arranged as to connect an attribute or property with the subject of the first propositions, apparently foreign to it, through a group of inferences in which the connexion is intuitively discerned. Thus restoring the suppressed premiss in each of the inferences drawn by Lord Eldon, in the illustration already cited, we should get the following train of reasoning. Whatever contradicts Scripture is contrary to law; this book contradicts Scripture; therefore it is contrary to law. Though the major and minor premiss would be contested by a civilian of the present day, in Lord Eldon's opinion the latter was only open to cavil, and he consequently sought to place it beyond dispute by an additional inference: Whatever leans to materialism contradicts Scripture; this book leans to materialism; therefore it contradicts Scripture. But the phrase "leans to materialism" is rather indefinite, and it might be fairly argued that the "Natural History of Man" did not fall within its sphere; the judge, therefore, proceeds to clench his argument by placing the book in the category of things that lean to materialism, because it contradicts the immortality of the soul. We in this manner obtain two syllogisms in corroboration of the minor premiss of the first argument. Such combinations of inference it is evident will grow more complex and involved in proportion as the two terms of the conclusion is removed from the middle in the syllogism whose validity we seek to establish; as the farther the distance, the more numerous will the intermediate links become through which the connexion is demonstrated.

These trains of reasoning exemplify certain laws and

methods, are employed about different degrees of belief, and rest upon various foundations of evidence. Each of these divisions, developed in corresponding chapters, will form the subject of the present book[1]. In this view it will only be preliminary to the great design of logic, viz., the representation of the valid forms of inference employed in the construction of the moral and physical sciences, and will serve (to use a Baconian phrase) as a kind of *prodromi*, or anticipations of those principles of evidence to which all the preceding parts of logic converge. From the exposition of the laws of simple cases of inference to that of the multiform functions which they fulfil in the construction of the two great branches of knowledge, is manifestly too wide a step to be taken at once, and it is but consulting the methodical expansion of the science to interpose between them a survey of the different grounds of evidence on which those inferences rest, the primitive truths into which they can be resolved, together with the laws and methods which they exemplify, and the various degrees of belief which they excite in the subjective

[1] The common school logics generally terminate with the first member of this division, viz., Method, and leave the young logician in total ignorance of the mental laws which the theory of reasoning is supposed to illustrate, of the foundations upon which it is raised, and the different forms which demonstration and induction assume in the various sciences, to which the preceding subjects are subsidiary. Such a procedure, which is not an unapt illustration of the play of "Hamlet" with the part of the Prince omitted, doubtless arose from the common habit of teaching the science in our universities before a course of physics was entered upon; but we hope, after Mr. Mill's "System of Logic," the abuse will be corrected. If logic, both in the continental and our home universities, is deemed an essential propadeutic to the study of theology and ethics, it must be deemed equally necessary to the study of natural philosophy. In both cases we have distinct groups of knowledge raised out of various combinations of inference; and if it is essential in the pursuit of the moral sciences to have the general principles upon which the evidence proceeds, in our grasp before we proceed to master the particular details, the same course ought to be pursued in physics. Hence, Sir John Herschel has very properly made this subject one of the leading divisions of his Preliminary Discourse on the Study of Natural Philosophy. Dugald Stewart (Philos. of the Mind, *passim*), however, thought logic ought to follow, and not precede, the study of the sciences, a view in which Dr. Whewell seems to coincide, by making their philosophy supplementary to their history. We, notwithstanding, deem this opinion a very erroneous one.

mind, that the reader may be presented not only with all the mechanism of the formulæ of reasoning, but have a clear insight into the structure of knowledge which they are employed to raise, and a complete view of the foundations upon which the edifice reposes. In pursuit of each branch of the subject we shall have to encounter two objections of a very formidable character, either of which, if admitted, would prove fatal to the system of logic propounded in this work. The first is, that which resolves all our knowledge into a series of inductive generalisations; with its two necessary corollaries, viz., that the interpolation of the major premiss in a syllogism is an assumption of the thing to be proved (petitio principii); and that there is no such thing as necessary truth existing, unless what is of hypothetical creation. The second is, that which denies the existence of anything like certainty either in reasoning or in the first principles that inference assumes, and which consequently attempts to rase every scientific structure to the ground. The answer to these objections will bring into court everything connected with the *rationale* of evidence, and expose every artifice that human ingenuity has contrived to convict its methods of falsehood and illusion.

CHAPTER I.

UNIVERSAL METHODS OF INFERENCE.

§ 1.—*Analysis and Synthesis.*

Reflection cannot be exercised, and consequently no modes of reasoning be pursued, without viewing the object about which they are employed in either of two ways: viz., as an obscure whole, whose parts are to be resolved, or as a group of detached parts to be linked together in the form of a constituted whole. The first process is called analysis, from a Greek word, signifying decomposition[1]; the last, synthesis, from a term derived from the same source, designating recomposition. These are the two vital functions of methods—the two essential accompaniments of all thought—as systole

[1] For the different modes of analysis, see History of Logic, pp. 2, 11, and 15.

and deastole are the living conditions of the animal organism.

This will be more evident on interrogating ourselves as to the nature of truth. In what else can it consist, unless in the relation of things to each other; and by what other mode can that relation be investigated, unless by mounting from their primitive elements to their successive combinations; or by descending from these to the simple parts out of which they arise? Nature, by the process of growth and decomposition going on within her, is continually weaving and unravelling the complicated web of existence; and, in whatever position the threads may be placed, they can assume no other relation than that of combination (synthesis) or disentanglement (analysis).

Although each of these methods vary in some degree, according to the subject-matter of the different sciences in which they are employed, they nevertheless preserve in their widest diversity those distinctive features which mark them out as varieties of one species, and as such may be used to illustrate each other. Thus logical analysis, by which a process of inference is resolved into syllogisms, and syllogisms into propositions,—and then again into the two terms and copula which form the connecting link, or by which any of these parts may be again resolved into the divisions which we have already comprised under them,—is perfectly analogous to the analysis which the chemist employs to get at the ingredients of any mixture in his laboratory, or to that which geometricians make use of when they convict any theorem of falsity, by pointing out the ridiculous inferences to which the assumption of its truth must lead. The same may be said of the various synthetic processes which obtain in the different sciences, as these are but the inverse methods of the corresponding analysis out of which they arise, and consequently manifest in the same degree an opposite unity of method. Distinct, however, as the two paths are by which the stream of knowledge is either descended to its source or pursued out into the wide arm which unites all its tributary branches, they are commonly more or less blended in every large train of inference; and where the investigation is of such a nature as to allow either of the methods to predominate, they are sometimes confounded together, through the process re-

ceiving the name of the prevailing method. Thus symbolical reasoning is generally termed analytic, because we do not necessarily here, as in geometrical reasoning, proceed by linking one truth to another till we reach the desired result; but commence with stating the unelicited truth, or the given combination of known quantities in its symbolical form, and then proceed, in conformity with certain axioms, to trace what other truths are involved in the one first stated; resolving step by step the symbolical assertion with which we began into others, which gradually reveal the meaning of the unknown quantities which entered into the original statement. Now the first process, which consists in forming out of the quantities presented by the conditions of the question one equation, is evidently synthetic, while the subsequent steps of the proof is analytic; but as the latter comprise the main branch of the procedure, all symbolical reasoning became confounded with it.

With regard to the relative value of these two methods, that must be determined according to the subject which presents itself for investigation. In physical science it is evident there can be no correct synthesis before analysis has legitimated the use of that method, inasmuch as we can boast of no revelations of the mysteries of nature but those which arise from anatomising the interwoven mass of facts which she presents, and acquainting ourselves with the mutual bearings of their distinct parts. Thus, how vain would have been the attempt to manufacture lapis-lazuli until we had discovered that the components of the stone were silica, alumina, soda, sulphur, and a trace of iron; or to seek to discover, at least without a number of wasteful experiments, at what point of space the curved path of a given shot will terminate, before examining the laws which the cannon-ball obeys from the first moment the match has been applied. We might, indeed, in the first instance, have accidentally thrown together the five components of ultra-marine[1] in the exact proportion required to produce the beautiful pigment referred to; but such an instance would have given us no power to produce the combination at will, and still left us dependent on the niggardly supplies which nature doles out,

[1] As did really occur in 1710 in a furnace used for the manufacture of alkali.

of this beautiful material. By chemical analysis, however, we have wrung out of nature one of her important secrets, and are thus enabled (verifying a prediction of Lord Bacon) to produce frequently what she does rarely, and to achieve in a moment results which she takes centuries to consummate.

In physical science, therefore, the legitimacy of all synthesis is in direct proportion to the preceding analysis. If we attempt to synthesise or construct a system of science before the analysis of the parts to which it refers is complete, the result is a false science; just as, if we rest content with simple analysis, and do not attempt its corresponding synthesis, as far as its data would warrant such a procedure, the result is an incomplete knowledge. But, if an error is to be committed, the latter course is much preferable to the former, as an analysis, one day or other, is sure to find its synthesis; while, if we commence with synthesis, there is no return to the true path unless through the demolition of the vague hypothesis which such unwarranted synthesis has constructed. Of this truth the history of science is nothing less than a series of illustrations. Aristotle, through leaping at inference before a complete analysis of the facts upon which his mind was employed, affirmed that the matter of the sun was incorruptible; and the falsity of the assertion was not detected until the examination of the sun's disk by means of the telescope discovered spots in that luminary. Ptolemy, with a very incomplete analysis of celestial phenomena, attempted to construct the whole theory of celestial mechanics. The result was, that astronomy for nearly fourteen hundred years was kept embedded in the ruck of fiction, and could not advance until the orbs and epicycles with which he had peopled space were swept away, and the analysis recommenced from the point at which it had been broken off. Thus the entire course of philosophy has been no other than that of analysis with synthesis following in its train; and the impediments which have constantly beset its path have sprung from no other source than the rash commencement of such synthesis before the corresponding analysis was made out.

The contrary principle, however, may be said to obtain, in all cases where law and revelation are concerned, concerning either particular doctrines or individual acts. For then we arrive at results, not through the dissection of the matter to which they refer, but by linking successive cases to each

other, in conformity with the laws enunciated in the revealed proposition. Everything consequently must be made to meet the truth which it expressed, either directly in itself or by its immediate consequences, as coming from an impugnable authority; and hence arises the opinion[1] that, not alone in the moral sciences, but in every complete system of knowledge which professes to trace the relations of all science to each other, and their mutual blendings and ramifications, the synthetic element must predominate and give the tone to the rest. This ground, however, is of too uncertain a character to warrant any kind of dogmatism, and the best course to pursue, is that of conceding to each of the two great branches of knowledge the predominance of their correlative methods, while we refrain from thrusting forward a probable inference in one department as sufficient ground for oversetting a legitimate conclusion in the other.

As in revelation we are not said to discover general laws, but merely infer cases from laws already given, the synthetic process, which is its method, is not said to discover truth, but only to demonstrate it when discovered; while that of analysis, which prevails in the physical sciences, brings new truths to light, both with regard to particular facts, and the general laws which are shown to arise out of them. Both, therefore, may serve as verificatory processes to test each other's legitimacy; since as truth is always in unison with itself, a fact which has only been analytically inferred, is doubly confirmed when found to be in accordance with moral truth, and to stand the test of the correlative method; as a principle, must shine forth with clearer lustre when it derives renewed confirmation from the analytic examination of particular facts. There is consequently no fundamental opposition between the two methods, nor can they ever be viewed as conflicting, unless from an erroneous conception of the nature of the sciences, and the uses to which they are applied.

Though the direction of these methods must depend in a

[1] Propounded by Gioberti in his Elementi dello Studio di Filosofia, tom. ii. cap. ii., and covertly stated by Chretien in his work on Logical Method, p. 218. These writers, in this case, are only the exponents of the views advocated by Catholic theologians both at Oxford and Rome; but all the experimentalists and eclectics, with Victor Cousin at their head, condemn this view. See l'Introduction à la Cours de l'Histoire de la Philosophie, by the latter. Troisième Leçon.

great degree on individual sagacity, the rules which Descartes laid down may not be without their use, if kept steadily before the eye in all cases of investigation. They are, with regard to analysis, as follows:—1st. Never to accept anything as true which we do not clearly know to be so. 2nd. To divide each of the difficulties we examine, into as many parts as possible, and as may be necessary for resolving it. 3rd. To arrange our thoughts in order, by commencing with objects the most simple and the most easily known, in order to ascend by degrees to the knowledge of the most complex. 4th. To make, in relation to everything, the enumeration so complete and general, that we may be assured of having omitted nothing. The synthesis are thus given in the second part of the same work on Method:—1st. To leave no ambiguity in the terms, by having due recourse to definition. 2nd. To assume only clear and evident principles, which cannot be contested by any persons. 3rd. To prove demonstratively all the conclusions advanced, by employing no other means than the definitions and principles (axioms) already laid down.

CHAPTER II.

UNIVERSAL METHOD OF INFERENCE.

§ 1.—*Induction and Deduction—Meaning of the Terms.*

If any train of reasoning be minutely examined, it will be found to proceed either in a descent from the more general to the more particular, resolving a whole[1] into its parts; (analysis), or in an ascent from the more particular to the more general, or framing out of the particular parts a constituted whole; (synthesis). The former is called deduction, the latter induction. Thus the physical sciences are commonly called inductive, because they consist of a series of generalisations, founded on the most circumstantially stated particulars, and carried up through intermediate axioms to universal laws, which comprehend in their statement every subordinate degree of generality; while the abstract sciences are usually

[1] Which may be either of intension or extension. Sir W. Hamilton restricts it to the former, see Ed. Rev. vol. lvii., but he is evidently in error.

termed deductive, because they follow the inverse method of proceeding from general axioms to particulars, by which these axioms are traced back to their remote consequences, and all the particular results deduced from them which are included in the general proposition. Of course each branch of knowledge not only admits, but even exacts as the condition of its perfection, the blending of the two methods, but they are generally so designated, as one or the other element predominates in the proof and fashions its initiatory processes.

Every inductive train of inference, as well as deductive, is capable of being resolved into its appropriate syllogisms, and is consequently amenable to the laws of the universal canon of reasoning; the only difference between the two forms in this respect being that, though the former equally ranges through all the figures, it finds its most natural expression in the third, while its deductive counterpart finds its most direct form in the first. By employing the same symbols, the correlation of the two processes may be thus exemplified:

Inductive.	Deductive.
x, y, z are a.	b is a.
x, y, z represent the class b.	x, y, z are contained in b.
$\therefore$ b is a.	$\therefore$ x, y, z are a.
or,	or,
a contains x, y, z.	a contains b.
x, y, z constitute b.	b contains x, y, z.
$\therefore$ a contains b.	$\therefore$ a contains x, y, z[1].

In the syllogisms the order of the terms remains unchanged, but that of the propositions is reversed; the conclusion of the one forming the major premiss of the other. Of the terms the major is common to both, but the middle term in the deductive syllogism becomes the minor in the inductive; and the individuals which are the minor, or determined notion in the deductive syllogism, become the middle term, or determining notion in the corresponding inductive syllogism[2]. The one process, according to this view, is only an inverted counterpart of the other.

[1] Mr. Karslake, estimating the inductive by the deductive syllogism, restricts the former to the 3rd fig. The scheme of Sir W. Hamilton in the text presents the more correct doctrine. See Aids to the Study of Logic, vol. i. p. 89, by W. H. Karslake, B.A.

[2] Hence Aristotle

§ 2.—*Different kinds of Induction, Formal and Material. Syllogism erroneously confounded with Deduction.*

Much confusion of thought has arisen through the absence of distinction between the matter and form of induction, and the propagation of the error thence resulting, that because it proceeds in an inverted method to deduction, and is generically applied to designate a distinct class of truths, it must necessarily denote a species of inference not contemplated by the founder of logic; a view which is countenanced by the fact, that in the days when the laws of the syllogism were evolved, no such thing as inductive science could be supposed to exist. Hence that class of moderns who, like Bacon and Dugald Stewart, will admit of no other correct elementary process than induction, are led to throw aside the syllogistic doctrine both as practically useless, and as an imperfect exposition of the theory of inference[1].

seems to have had a correct idea of induction when he affirmed it to be a syllogism in which the major is proved of the middle by means of the minor; *Επαγωγὴ μὲν οὖν καὶ ὁ ἐξ ἐπαγωγῆs συλλόγισμὸs τὸ διὰ τοῦ ἑτέρου θάτερον τῶ μέσῳ σολλογισασθαι.* (Pr. Anal. ii. 23, § 2.)

[1] It is amusing to hear Bacon state his grounds for rejecting the syllogistic theory, which he rather naively left to mob orators and theologians, to whom he imagined correct reasoning was only a secondary matter: "At nos demonstrationem per syllogismum rejicimus . . . quod syllogismus ex propositionibus constet, propositiones ex verbis, verba autem notionum tesseræ ac signa sunt. Itaque si notiones ipsæ mentis male ac temere a rebus abstractæ fuerunt . . . omnia ruunt. . . Rejicimus igitur syllogismum neque id solum quoad principia sed etiam quoad propositiones medias." Introduction to the Instauratio Magna. This extract clearly shows that Bacon was entirely ignorant of the principles he condemns, or he could not have written *middle propositions* for *middle terms*, or urged as a reason for the rejection of the school logic the singular fact, that it was open to the illusion of language; for what reasoning is not? Bacon in this extract rejects middle terms as useless, yet he could not reason without them, and was necessarily as unsparing in their use as St. Thomas Aquinas.

A great deal of the current notions about the inutility of logic springs from the confusion which such loose writing tends to involve the old and new methods. We have seen a graduate escape from the hard necessity of allowing himself to be convinced that he was arguing with a middle term particular in both premises, by declaring that facts were better than syllogisms, when the forms of his argument would have proved that men are plants because they require air. "I," he exclaimed, "produce facts like Bacon, you quibble about their combination with Aristotle."

The error appears to us to have arisen in a great degree from the application of the term induction to the process in which there is really no illative inference at all—viz., the objective process of investigating particular facts as preparatory to illation, which is entirely intuitive, and also from imagining, because the truths arrived at by the process of illative induction are ordinarily tested by certain experimental canons of inquiry and the laws of the Calculus, that it is entirely foreign to the class of truths which the syllogistic theory contemplates. The confusion, however, will disappear on considering that the syllogism, after all, only presents a mode in which an inference may be tested as to the conclusiveness of its form, and that for this purpose its mechanism is quite as available for inductive as for deductive reasoning, in all cases where an illative inference has been drawn. Now, if a train of reasoning can err on its formal side as well as with respect to its matter, it is surely no good reason to infer, because we are provided with a code of principles by which the latter may be tested, that we are quite at liberty to neglect the rules which relate to the correctness of the formal illation.

In both these respects with regard to induction, the ancients and moderns appear to have entertained inverse misconceptions. Bacon and his followers have marvellously advanced the doctrine of material induction, but have entirely mistaken the import of its formal laws, and the functions they are calculated to discharge. Aristotle[1], on the other hand, was right with respect to the form; while in relation to material induction, or the mode of obtaining the materials, and determining under what circumstances certain individuals could be said to constitute or represent a class, he was obviously in error. For though in addition to the induction *per enumerationem simplicem*, or that which required every individual of a class to be tried, before they could be affirmed to constitute a class, he seemed to admit the induction of a class from a few of the objects which it embraced, founded on the general analogies of nature; neither he or his followers had any distinct conception of the kind of evi-

[1] Aristotle attributes the *discovery* of induction to Socrates, deriving the word επαγωγη from the Socratic accumulation of instances serving as antecedents to establish the requisite conclusion.

dence required to warrant such induction, but from a few or a single instance, and even more frequently from no instance at all, but only from some fancied analogy, they jumped at a universal law, and strove to submit nature to the fanciful hypothesis thus obtained, by concealing every objection calculated to weaken or overthrow it. The moderns, with Bacon at their head, therefore, justly allege, that instead of proceeding from well-grounded particulars through the platform of intermediate axioms up to general laws, they rushed up to *axiomata summa*, and then attempted to deduce the *axiomata media*, by which they ought to have ascended; a method which of course involved them in undue assumption, and proved the source of irretrievable error[1].

As an instance of the mistake of the moderns with regard to formal induction, in addition to those already given, may be cited the attempt to identify syllogism with deduction, and the reduction of reasoning in the inductive form to the first figure with a view to show that all reasoning is syllogistic in the deductive sense of the term. Aldrich describes induction as a kind of enthymeme or syllogism in *Barbara* with its minor suppressed[2]; viz., "This, that, and the other magnet attract iron, therefore all magnets attract iron." Though the illustration he gives, if thrown into a syllogistic form, would really require a major to be supplied, and not a minor. Thus,

Whatever belongs to this, that, and the other magnet, belongs to all;
Attracting iron belongs to this, that, and the other magnet;
Therefore attracting iron belongs to all.

We are, consequently, obliged to infer that he inverted the premises; in which case the inference would be unintelligible.

Archbishop Whately, on the other hand, takes the suppressed member of the syllogism in induction to be the major[3], and reduces that method of inference to the deductive form in the following manner:

[1] See Karslake's Aids to the Study of Logic, vol. i. p. 97. [2] Artis Logicæ Rudimenta, p. 175. [3] Whately's Logic, b. iv. c. i. § 1.

Whatever belongs to the individuals we have examined, belongs, certainly or probably (as the case may be), to the class under which they come.
Sheep, deer, and other individuals deficient in upper cutting teeth, are found to ruminate;
Therefore all animals deficient in upper cutting teeth ruminate.

Although many instances of induction like the ones adduced may be exhibited in a deductive form, yet this does not prove that all can; nor does the transformation add to the cogency of the inductive inference, but rather weakens its force, by representing it in an unnatural manner. Thus,

Sir Thomas More was incorruptible,
Sir Thomas More was a judge;
Therefore some judge or judges are incorruptible,

would appear in the first figure as,—

Sir Thomas More was incorruptible,
Some judge was Sir Thomas More;
Therefore some judge is incorruptible;

in which form there is not one trace of deduction, nor is the inference strengthened, but despoiled of much of the illative force it bore in the third figure. There is consequently no object to be gained in such reduction, since each figure has its own particular rules for testing the validity of every argument that falls within its confines, and none of the *dicta*, so far as certainty is concerned, exercises a prerogative over the rest. As long as the *dictum de omni et nullo* was considered as the paramount law of correct inference, there was some pretext for reducing all arguments to one of the four moods of the first figure, to which that dictum is alone applicable, and considering deduction as identical with syllogism; but since that view has been disclaimed, there is as much reason —and some think far more reason, as we shall presently see— for resolving all deduction into the inductive process, as there is for the contrary procedure.

§ 3.—*Theories of Reasoning.*

The false views which arose from making deduction synonymous with syllogism have invited attacks from dif-

ferent quarters on the whole doctrine of the school logic, which, though varying in some degree in their form, resemble each other so far in their general features as to denote a common origin—

facies non omnibus una
Nec diversa tamen; qualem decet esse sororum[1].

and, consequently, admit of being dealt with in an aggregate form. The common principle from which they spring may be traced to the assumption that all axioms are but generalisations from particular facts; that there are no such things existing as *à priori* truths, given, as Kant would say, as ultimate principles of our intellectual constitution; and the consequent corollary that all inference is from particulars to particulars, and that general propositions being mere registers of such inferences, when interpolated in an argument, add nothing to the proof, but simply refresh our memories with the number of cases in which the law we are about to apply to a new instance has been already observed. Thus, when it is inferred, from the fact of the present Premier being a man, that he must die, the major premiss from which we infer the conclusion is not all men are mortal, for that would involve a *petitio principii*, but simply the number of particular cases in which we have observed mortality to be a mark of the class men[2]. Nor is the formula of previous instances in which the inference has been drawn necessary to be looked at on all occasions, as there are a great quantity of particular inferences evident from the bare statement of the minor. We would not require, in order to affirm that the lines *A*, *F*, and *B*, *C*, from being equal to *M*, *N*, are equal to each other, to recur to former cases in which we had observed the truth of the axiom, that things which are equal to the same thing are equal to each other. The bare enunciation of propositions of this character is sufficiently evident of itself, without any previous generalisation, to carry

[1] Met. b. ii. 14.

[2] This is Mr. Mill's view, but Dr. Brown will not even concede so much, but affirms it is only necessary to know that mortality is associated with the idea of man to predicate that quality of any individual. Thus, "Prince Albert is a man; therefore Prince Albert is mortal." But the doctor does not seem to have been aware that the knowledge of mortality being an essential constituent of man's nature, previous to making the inference, was in reality the very assumption of the major premiss, "all men are mortal," which he so stoutly ignored.

conviction to the most undisciplined understanding as soon as they are understood. The syllogistic theory, therefore, is not the universal type of reasoning, but inference from particulars to particulars through marks of marks. The conclusion of an inference not being drawn from a general proposition, even when it may be advisable to consult it by way of collateral security, but according to it; such general proposition cannot be considered as the real antecedent or premiss, but the particular facts from which that general proposition was inferred. Accordingly the rules of the syllogism, and, in fact, every artifice which the peripatetic logic embraces, beyond absolute definition, is perfectly useless in the sense of the Scotch school; and the work should be at once sent to the trunk-makers, were it not as well, for the purposes of curiosity, and out of respect to the past, to preserve so cumbersome a piece of mechanism, by which the human species at least, for nearly two thousand years, consented to guide the operations of the reasoning faculty[1].

Some recent logicians, though entertaining fundamentally the same views, do not go so far. Though we do not draw the inference in reasoning from the general proposition, where such is employed, it is necessary to preserve consistency between the particular conclusion we infer from the minor premiss and our former experience expressed by such general proposition; and the rules of the syllogism serve as an indispensable guarantee for that purpose. The use of the syllogism is consequently nothing else than the use of general propositions in reasoning; and these are only certain formula generalised from the results of our former experience, to determine what inferences may be drawn in any particular case. The work of drawing the inference is that of applying the formula, and the rules of the school logic are a system of security for the correctness of the application[2].

This middle ground, between the Scotch school and the peripatetic logicians, was raised with a view to defend the syllogism from the charge of really assuming the conclusion in the premises; an accusation that certainly had some

[1] See Reid's Analysis of the Old Organon, Art. Categ.; Dugald Stewart's Philosophy of the Mind, vol. ii. *passim;* and Dr. Brown's Lectures, *passim.* [2] Mill's System of Logic, vol. i. p. 269. He, however, does not give these rules, but somewhat naïvely refers his readers to Dr. Whately for them, as evidently too trifling for his notice.

colour of plausibility so long as the syllogism was confounded with deduction, and made to guarantee the cogency of every inference that could be thrust into the four moods of the first figure. For if we argue, from every man being a responsible agent, that the present Emperor of Russia is accountable for his actions, it is evident we assert no new truth, but merely particularise, or draw out of the general formula (major premiss), one of the single instances already included under it. Such a form of reasoning it is consequently contended is incompetent to advance us one step in the progress of knowledge, or to corroborate any truth; since it falls into the sophism which renders the conclusion a mere tautological repetition of the premises. Yet, taking logic on the high ground of the deductive syllogism with which its adversaries have confounded it, there is need of little ingenuity to invalidate the charges alleged against its method. For waving, at present, the question how we come by the majority of general propositions, which is really the cardinal point in dispute, it cannot be denied that we frequently obtain such formula without realising one-tenth of the meaning they are calculated, when fully analysed, to convey; and that we can only exhaust them of their latent truth by casting about for middle terms, either by experiment or reflection, which link them with other classes of phenomena previously unknown to us, and thereby extend our knowledge. For example, when Newton first propounded his general law that material bodies attract each other with a force proportionate to the product of their masses directly, and the square of their mutual distance inversely, he hardly dreamt that the precession of the equinoxes could be deduced as a natural consequence of the same principle. Nor did Pythagoras, when he first realised the truth of the necessary relations between the base and sides of a right-angled triangle, think of the consequent development to which they subsequently conducted him in the construction of the 47th proposition: at least, he is said to have comported himself on the discovery of that famous Theorem as Columbus in sight of a new world, or as Kepler, when he found that the satellites of Jupiter verified his three celebrated laws of the elliptical motion of the planets.

To take another branch of cases, which are generally deemed more akin to the syllogistic scheme; viz., those con-

nected with the moral sciences, and concern either legislation, theological doctrine, or ethics. Whatever may be said as to the rise of general propositions from the agglomeration of particular instances in other sciences, it is evident they are presented to us in these subjects at the outset in a general form, and that all the subsequent stages of inferences which these sciences embrace consist in the application of such general formula, by means of middle terms, to particular instances never previously contemplated by us. All these deductions lead to new truths, so far as truths can be called new in the human sense of the term, and consequently must be looked upon as resulting in a real addition to our knowledge. What are all the doctrines, for instance, which each denomination of Christians have raised upon the teaching of Christ but so many inferences deductively inferred (how far rightly or otherwise is not for us to say) from the general scheme of doctrine he is reputed to have taught? To select a single case, it would be certainly going very far to aver that the colossal system of doctrines that the patristic fathers built on a few scattered texts of Scriptures were assumed in the premises from which they were deductively inferred; and yet all these tenets were embraced as original truths, latent, indeed, in the general propositions from which they were drawn, but not fully realised by the primitive Church, and that by the whole of Christendom in their day, and are so held by the majority of professing Christians now.

Now in all these cases, which extend over all the compartments of knowledge, when a particular conclusion is deduced from a general proposition, it is evident that the truth inferred must be in some measure contained in the premises to warrant the illation; but it does not follow that it must be *explicitly* involved but only in a *virtual* and *implicit* manner, in which case there can be no direct assumption of the premises in the conclusion, in which the *petitio principii* consists. The process of inference, in its deductive as well as its inductive processes, is perfectly analogous in this respect to the counter processes of natural truths which it seeks to evolve. There is no effect which is not implied in the cause out of which it springs[1], nor any state of nature which has not its

[1] Introduzione allo Studio della Filosofia da Gioberti, tomo secondo, p. 221; and Teor. del Sovr. note 44, p. 406, by the same author.

principles latently concealed in the state immediately preceding its existence. The phenomena, notwithstanding, are substantially different, though secretly involved and interlaced in one web of mutual dependence, so that one series of facts cannot arise until their principles have been furnished at least in an inchoate state, by another. If, therefore, the syllogistic theory is to be set aside on account of its implied assumption of conclusion in the premises, we must set aside all exposition of natural truths, and forego reasoning altogether[1].

We do not, then, require Mr. Mill's theory to defend even the deductive syllogism from a *petitio principii*; nor, we fear, can that theory be maintained without giving up the main uses of the peripatetic logic. For, if as that logician somewhat strangely avers, the formal portion of inference must alone be tested by the experimental canons of inductive inquiry; while that part which merely refers to the consultation of our former experience on the point at issue, and keeping our inference in harmony with it, can only fall under the surveillance of the syllogistic rules, the entire use of logic is at an end[2]. The functions which it has to discharge relate entirely to that part of inference which Mr. Mill denies its competency to fulfil; nor can it throw any light on the interpretation of the general formula by which we seek to cover any particular conclusion we have inferred. The latter supposition is, in fact, ludicrous, and requires a very Quixotic imagination to combine the two things in the same theory. What help can mood and figure with the heavy accompaniment of a group of rules and canons which exclusively relate to pure inference, lend to the interpretation of general propositions formed from the results of one's individual experience? The

[1] Baron Galluppi, in his Lezioni di Logica, answers this futile objection in another way. While he allows the two terms of the conclusion are fairly contained in the premises, he denies that the illation is contained, in which the truth of the conclusion exists. The latter he designates the formal part of the syllogism; the former the material. The inference of course springs from the comparison of the two terms of the conclusion with the middle, and as the result of that act is only expressed in the conclusion, the premises can by no means be said to contain it. The logicians whose opinions we combat in the text confound the formal with the material part of the syllogism; but though we see the latter intuitively, it does not follow we see the former,—as we have before observed, a middle term is necessary to distinguish it. [2] See Mill's Logic: Functions of the Syllogism, where he distinctly propounds the doctrine in the text.

syllogism, even in its deductive dress, which Mr. Mill takes to be an essential part of its nature, has no more relation to such a function than a flail has to the office of a windmill, or a piston-rod to the uses of a compass. The canons of inference were exclusively framed to guarantee the reasoning process. To deny their competency in their proper sphere, and apply them to objects in which, as Mr. Mill asserts, no inference is concerned, would be a burlesque upon the ordinary notions of adaptability between end and means.

The only things which can be of any service in the interpretation of general propositions are a clear perception combined with a capacious memory; and Dugald Stewart was consequently more consistent when entertaining the same principles with Mr. Mill, he rejected the syllogistic theory altogether, and resolved all reasoning into intuition and remembrance.

§ 4.—*General Truths exist independent of Experience.*

Even in the supposition that all general propositions are the result of experience, it would by no means follow that the school logic was practically useless; since such an hypothesis could not preclude an argument from being inconclusive as to form, or present us with any means of detecting its inconclusiveness different from that of throwing it into the syllogistic form and bringing it under the universal canon of inference. Nevertheless, the assumption would tend to weaken the syllogistic doctrine, since it would show that reasoning, at least in its elementary stage, was purely restricted to one premiss, there being no common principle to serve as major until a number of particular inferences had become agglomerated into a general proposition. Now, we fairly put it to each one's consciousness, whether such an exposition of the manner in which he registered his first inferences is correct. When a child has once felt the consequences of playing with fire, does it ever trust itself again with the dangerous element? What need has it of a second experience to certify that sugar is sweet and acids bitter? Do the number of instances in which these objects are felt through the course of the longest life add a single iota of strength to the first inference? If no one can say that they do, without contradicting the general experience of his species, then is that first inference a general proposition not singly inferred from the

individual case, but from a constituent principle of our intellectual constitution taken in conjunction with it, which interiorly assures us, that whatever qualities we have found in combination with particular phenomena, will invariably accompany the subsequent repetitions of that phenomena[1].

If our inferences never travelled beyond the particular cases out of which they spring, it would not only follow that each repetition of the inference would act as an additional guarantee for applying it to an indiscriminate number of similar cases, but that all the relative degrees of certainty, as well in different minds as in each individual's consciousness, would arise exclusively from the number of times the particular coincidence, or disagreement, about which it was employed had been experienced. To this indisputable consequence of the assumption of the empirical nature of all general propositions each one's experience gives the lie. For though there are a class of facts that absolutely follow that law (as those connected with contingent events), and result in general propositions of an empirical character, there are other classes of truths which do not require any sensible experience to assure the mind, that they include every concrete case to which they are capable of being applied as abstract propositions, the truth of which the mind perceives intuitively in its ideas; while there is an additional class which require one exemplification of the inference, but after that are so indubitable and certain in their character, as to be instinctively generalised on the spot, and extended to every subsequent instance of the same phenomena. The indispensable corollaries of the doctrine, that all general propositions are only agglutinations of particular inferences, do not agree with the facts of which each one's own consciousness is a steady witness; the principle itself is, consequently, to be rejected as untenable.

Mr. Mill has attempted to confound abstract, or necessary truths, with those of a physical character, by resolving them into hypothetical notions, and making the necessity, which

[1] Sir W. Hamilton will not admit this principle, because it does not necessitate, but only inclines. We should like to know if the worthy Edinburgh professor ever so far doubted of the burning qualities of fire as to put his hand into a flame twice, or ever refused to eat bread because he mistrusted its nutritive properties. With all due respect to so high an authority, the practical exemplification of the principle he lays down would be a mark of insanity.

we suppose to accompany them, the simple result of habit, in conformity with the consequence which we have attributed to his principle. But here, again, this acute philosopher is strangely at strife with himself. For if such propositions be hypothetically true, it is evident they must be held necessarily so, as long as the hypothesis is maintained, otherwise it would be competent to any one to aver that the same thing could be and could not be at the same time. It is, therefore, absurd to say, with such a doctrine in the foreground, that their necessity springs from habit[1].

But does the necessity of necessary truths spring from their hypothetical character, and can the latter mark be supposed to exist in combination with them? We think neither of these cases can be maintained. In the first place, there is a class of necessary truths, even conceded by Mr. Mill[2] to bear no evidence of hypothesis about them, which are, notwithstanding, held by the mind with the same intuitive certainty as those which he deems of a suppositive character. That the two sides of a triangle must be always greater than the third; that two straight lines cannot enclose a space, and truths of a similar character, do not involve the least particle of hypothesis in their statement, is universally admitted, yet they are embraced as soon as enunciated, with the same confidence as the propositions which refer to the

[1] Dr. Whewell very properly distinguishes necessary from contingent truth by the utter impossibility of the former being otherwise than it is. Thus, to take a numerical instance: 3 and 2 are 5; we cannot conceive them, by any freak of thought, to make 7 (Phil. Ind. Sciences, i. 54, 55). In reply, Mr. Mill takes the inconceivability of the reverse of a proposition as the only sign of its necessity, and attempts to prove the futility of such a mark by citing cases of doctrines (such as the antipodes) once deemed inconceivable, which have nevertheless subsequently taken their place as scientific truths. But this is playing with the double sense of the word inconceivable in a manner which is unworthy of a logician of Mr. Mill's attainments. The term evidently can be, and is very frequently, applied by Dr. Whewell, to denote two classes of objects; one which cannot be entertained without conflicting with the primary laws of the reasoning faculty, and the other which, like some of the truths of revelation, surpasses our comprehension, simply because the truths it embraces belongs to a class of subjects which, either through defective faculties, or want of means of information, we are unfitted to realise. It would be doing injustice to Mr. Mill not to suppose that he understood Dr. Whewell to take the term in the passage animadverted upon in the former sense.

[2] Logic, vol. i. Art. Demonstration and Necessary Truths.

equality of the radii of a circle that is supposed to depend upon the possibility of abstracting length from breadth for its acceptance. Whence comes the difference, if both classes of necessary truths are held with the like uniform and unvarying degree of certainty by the believing mind? Even if we were disposed to save Mr. Mill from the consequences of his first inconsistency, which his words, however, will not allow us to do, and assert that the truth of the purely suppositive group springs from their hypothetical character, while that of the contrary class arises from habit, the distinction could serve no purpose, unless to overthrow Mr. Mill's doctrines. For in that case the indisputable consequence would follow, that the hypothetical class must be granted as soon as the condition was expressed; while that series whose truth was the mere creature of habit and association, would be received with doubt at first, and go on increasing in certainty according to the number of times the phenomena in which they first took their rise was repeated. But such a supposition is at war with the plainest truths that consciousness reveals to us, and could not be entertained without convicting the first principles of reasoning of imposture.

We can only escape from such false consequences by ascribing the uniformity of belief, with which all abstract truth is held, to the necessary relation between the classes of our ideas out of which they spring—a relation which is assented to in the same moment as it is intuitively perceived, and instead of depending on experience does not require one confirmation from that source to assure the mind that it includes all the cases that actual reality can bring under its judgment. When we say that two straight lines cannot enclose a space, or affirm that the radii of a circle are equal, there is no more hypothesis in the last proposition than in the first; since we do not affirm that the things of which we speak exist out of our conceptions, but that both are necessarily true as beheld in the percipient mind. Even viewed with relation to external objects, the only condition that is required in either case, is the existence of space and sensible lines to which they can be referred. For it is no more necessary that such lines should exist without breadth to realise the truth of the last case than that of the first; since the radii would still be equal, if drawn to the very edge

of the circumference of the circle, and in that sense would fulfil the condition imposed by the geometrical definition of a straight line[1]. But the fact is, owing to defective instruments, and the inexactness attending even the most delicate manipulations, the mind's conceptions can never be faultlessly cast into physical embodiments: but this by no means argues a want of reality in the conceptions themselves, but is to be ascribed to the grossness of our sensible perceptions, which are not fitted to embody abstract truth to a greater degree of perfection than is requisite to attain man's end in creation. If mathematical or abstract truth fall short of absolute perfection when carried into the material world, physical truth is in the same predicament, all concrete knowledge being only so many approximations to absolute reality. But to call either it or mathematical truth hypothetical on that account, would bring the whole structure of science about our ears[2].

From the foregoing considerations, we conceive ourselves fully warranted in drawing a distinction between three classes of truths existing in the mind; two underlying all our inferences from particular events, and the other furnishing the occasions by which either class are called into action. When we restrict our judgment to a particular event, the result is a simple intuitive truth. But when the inference travels further than the affirmation of the agreement, or disagreement of the terms in that particular case, a real illation has taken place; which, upon analysis, will be found to consist in the combination of one of the first class of truths (major) with the particular case (minor) which called it into being. Thus, when a child has once perceived that moisture is the effect of rain, it directly concludes that in all future cases it cannot come in contact with that element without getting soaked, from an interior conviction which assures it that similar effects follow from like causes; and which, expressly evolved, constitutes the major proposition to the

[1] Or the truth would be equally preserved if the line was considered to be of equal breadth. [2] The doctrine of hypothesis originated with Dugald Stewart. The only distinction between the two classes of abstract truth which Mr. Mill strives to discriminate by introducing the extraneous idea of hypothesis is, that one admits of direct, the other of indirect, proof, or *reductio ad absurdum*.

inference in question. If such a proposition be not in the mind instigating the judgment to leap to the general conclusion, then, we say, there is no ground for illation. For when the child forms a judgment in the absence of any such *à priori* truth, it is strictly of a particular character. Thus, it never concludes from the single fact that its nurse has been angry to-day, that she will be so to-morrow, simply because it has no general *à priori* judgment in the mind that could form a major premiss in combination with the individual case to warrant the supposition.

Nor is it even necessary to concede, though it does happen in many cases, that individual occurrences are required to call the abstract truth into being with respect to every particular phenomenon. Before a child has experienced a practical exemplification of the truth that every sound must have a cause, it is found to burst its drums and break its trumpets, with a view to explore the locality of the noise. Who has not smiled at his teacher when first set to learn the definitions of Euclid, for attempting to increase his knowledge by the announcement of the fact, that things which are equal to the same thing are equal to each other,—a truism as long familiar to his memory as his own identity. Such principles as these accompany the first exercise of thought, fashion the first judgments that the mind forms, and instead of being dependent on particular inferences, comprise the very elements out of which such inferences are evolved, and present the only means of testing, or legitimating, their validity. Had the divine economy ordered this otherwise, and left the child entirely dependent for its knowledge upon its own solitary experience, it would be the victim of destruction before leaving its nurse's arms; and such a thing as certainty could no more enter into the mind than the idea of colour into the conception of a blind man.

Such *à priori* judgments, which we agree with Kant in accepting as the ultimate elements of our intellectual constitution, may be distinguished into two classes, viz., those which have direct reference to external facts, and are only true in the supposition that the laws of nature remain and will continue immutable; such, however, may be denied, as we shall subsequently see in certain cases, without impeaching either the reasoning faculty or consciousness, of

error. The other class refers to necessary truth arising from the necessary relation between our ideas, and which cannot be denied without destroying the terms which constitute the proposition in which they are expressed. Into these classes of abstract truths and single intuitive judgments, both alike incapable of demonstration, we resolve all reasoning.

CHAPTER III.

DIFFERENT DEGREES OF EVIDENCE.

§ 1.—*Various Grades of Certainty.*

THE elements into which we have resolved the syllogistic process partly correspond to the three divisions of Aristotle, touching the modality of propositions, or the different degrees of belief with which a judgment is held by the mind, which the Stagyrite classes under the head of necessary, certain, and contingent (probable)[1]. The first term he refers to that class which spring out of the necessary relation between our ideas, and which are so absolutely true that they cannot be denied without invalidating the reasoning principle itself. In the scholastic sense, this class was usually styled metaphysical; and even God is declared incompetent to render them otherwise than they are, the things which they designate remaining the same; as the supposition would lead to the confounding the intrinsic properties of things. Physical truth, on the other hand, while capable of demonstrative certainty, is altogether dependent on the continuance of the laws of the external world, and consequently may be abrogated when the author of them chooses to suspend their functions. Physical truth, therefore, is confined to the boundaries of the material world, to space and time, and is dependent on the will of the Creator; while metaphysical truth exists absolutely and universally, and can in no instance be supervened without the destruction of the conceptions which enter into its composition. The supposition that Fresnel's law of the bifurcation of light in certain crystals was suspended, would by no means involve the destruction of either the crystallised bodies concerned or an illuminat-

[1] Prior Anal. i. 8. Αναγκαῖα: ἐνδεχομενα: ὑπάρχοντα.

ing medium; but we could not for a moment conceive lying to be a virtue, or a cylinder to be a sphere, without annihilating all the conceptions which enter into the respective terms of the judgment.

Contingent, or probable truth, comprises that wide class of judgments which depend upon events whose operations we are unable to investigate, and concerning which we cannot predict anything but with a very doubtful degree of certainty. That the weather will be fine to-morrow because it has been so to-day is a judgment that falls under this category, because we can furnish no other grounds for it than mere conjecture. This class of propositions is generally designated by the word chance, accident, &c., and was frequently so deemed by Aristotle and the ancients. But there is no such thing as chance or accident existing in nature, everything being controlled by systematic laws, and produced by the action of regular causes, the only difference being that, in the class of things termed contingent, we are unable to penetrate into their operation. The result of the Derby, for example, next year, depends upon the superior qualifications of a certain horse, the manner of treatment in the interim, and the honesty with which his owner and rider make use of his speed in the contest. But the issue at best can only be conjectured with probable certainty, because we cannot foresee the result of these causes or ascertain how far they will operate.

To this list the scholastics added that of moral truth, which, though when accompanied with strict marks of validity, falls somewhat short of demonstrative certainty, still approaches so nigh it that it may almost be ranked in the same category. Such are the foundations upon which rest our belief in the testimony of others, with regard to facts which we have not seen, and which impel us to believe historical truth, when accurately verified, with the same tenacity as we accept any scientific fact derived from our own investigation. For, that a number of men having no connexion with each other, and influenced by no personal motives, should conspire to cheat mankind with a lie, is a supposition which we can no more entertain than any notion which impeaches the reasoning principle itself. Yet in all such propositions there is room for cavil, as many find it difficult to convince themselves that all the required conditions have been

fulfilled; and when the testimony of individuals are inconsistent with the permanence and fixity of Nature's laws, some philosophers choose to abide by the latter, as more certain than the human testimony, no matter how well supported, which seeks to set them aside.

§ 2.—*Twofold Doctrine of Modality.*

The question of the different degrees of belief by which judgments are held, has been deemed of so unsatisfactory a character by many modern logicians, as to be excluded from the domain of the science, on the ground that the certainty affects the predicate of a proposition and not the copula, and as such does not come within the reasoning process. There is no doubt a quasi species of modality which only concerns the predicate, as when we say "the wine is *uncommonly* good," "the sun is *very* hot;" but this does not come within the proper definition of the term, and consequently must not be confounded with it. With regard to strict modality, the copula, as the link of connexion between the two extremes of a proposition, is undoubtedly modified by any variation of the certainty which exist between their union. If two weights are held together by a chain, any diminution or increase of the firmness with which they are held together must influence the chain uniting, and not the weights which it holds. The consideration of modality, therefore, becomes essential to any practical system of reasoning, for the conclusion can in no instance involve any further degrees of certainty than is contained in the premises; and if we would have the mind realise its full value, it is essential to know the amount of certainty that accompanies each premiss in the syllogism. Moreover, since the resolution of a point in dispute[1] will often depend upon the relative value we attach to different degrees of evidence, it becomes a matter of very great importance to consider how far, and in what respect, one class of judgments is more certain than another.

The complete doctrine of modality would consequently embrace every degree of belief which the mind is accustomed to attach to the different classes of its judgments, with the corresponding motives, commencing with the lowest grade of

[1] Such as of miracles.

probability and rising through the intervening shades of belief to the highest metaphysical certainty. Each of the divisions in that case already given, would admit of a minute subdivision. Thus, for instance, the class of moral truths might be arranged under four or five distinct heads. First, under that of historical testimony, which even in itself has different branches of certainty, that which relates to the destruction of Nineveh not being commonly received with the same credence as we believe the burning of Moscow or occurrences of a more recent date. In this respect, time seems to be, in some respects, the arbiter of the degree of belief we may attach to a fact depending on the testimony of tradition. The fate of Troy has long been considered of very doubtful authenticity, and the early account of Rome is beginning to loom through the twilight of fable, which may, if the world last long enough, in the lapse of ages overspread its entire history. Secondly, under that class of evidence which relates to the existence of the soul in a future state, the belief of an overruling Providence, and the impression that man in the next life will be punished or rewarded for his actions in this; all which judgments being incapable of demonstration or any very rigid proof, are accepted by a certain class of minds with great distrust, and even in the judgment of those really confiding in them, who form the vast majority of the human species, rest upon other foundations than the purely moral proofs which are alleged in their support. Thirdly, under that class of testimony which relates to present facts, whose reality any one, if he chooses, may go and convince himself of by the evidence of his senses. This class of truths is the most certain of any others depending on purely moral grounds, and men universally accept them with the same amount of credence as they receive the plainest revelations of their own consciousness. Fourthly, under that of ethical doctrine; for, though the majority of mankind are disposed to call things by their right names, and would really stone a man who ventured to preach up a loose morality among them, there are not wanting many philosophers of very acute penetration who affirm that, intrinsically, there is no more vice in adultery than in saying one's prayers, and that the vulgar distinctions of virtue and wickedness only spring from the conventional notions of society. That such opinions, if practically acted upon, would destroy

the ligaments by which nations and communities exist, is universally admitted; and since man was born for society, it becomes a matter not of very hard calculation to determine how far it may be presumed that either God or nature would make the condition of one of the great ends of his destiny dependent on a delusion.

§ 3.—*The same subject continued. Criteria of Evidence. The Doctrine of sufficient reason.*

The branches of physical truth may be divided into experimental and demonstrative. Both are received with sufficient certainty to displace doubt; but assurance is doubly fortified and strengthened when physical truth has stood all the tests of the demonstrative methods; for we then receive two different species of security for the existence of the fact, or law, whose validity may have been in question, which is tantamount to a confirmation from two distinct sources of evidence. The metaphysical portion of the general division may be considered under the heads of mathematical and logical. The first member is sufficiently evident, having been already dilated upon to some extent. The nature of the latter will fully appear in considering the different criteria which have been laid down by logicians for sustaining the mutual dependence and harmony of the different branches of evidence, both with themselves and with each other.

The first of these is, the principle of contradiction, viz., "that the same property cannot be at the same time affirmed and denied of the same subject." Thus, we could not maintain the existence of Kepler's laws while we believed in the Ptolemaic theory of the heavens, for that would be plainly tantamount to saying that the planets moved in complete circles, at the same time that they described an elliptic course through the heavens. Yet trite as even this principle may appear, it is more frequently violated in moral judgments than we imagine. For how often do we meet with men who talk about the existence of a free press in connexion with absolute monarchy, and who cast their lot with despotism while they affirm that all their opinions and predilections are in favour of absolute liberty? Indeed, there are a class of persons in whom this error is so deeply rooted, that their statements only cease to be contradictory when they become tautological.

The second criterion is the complement of the former, viz., "that conceptions which agree with each other can be in thought united or affirmed of the same subject at the same time," and is designated the principle of identity. The third is the principle of the excluded middle (lex exclusi medii): "Either a given judgment must be true of any subject or its contradictory, there is no middle course." The result of this criterion is, that we cannot accept one proposition as true without abandoning its contradictory as false, and *vice versâ*. If, therefore, we can prove that the contradictory of any judgment is true, we impugn its veracity quite as much as if we directly overthrew it. The principle of sufficient reason[1] may be said to form the fourth criterion of evidence, viz., "that every judgment must rest upon a sufficient ground or reason," which excludes from the consideration of evidence every belief rooted in ignorance, prejudice, or self-interest. From this law it would follow: first, that we cannot grant the reason without accepting what follows from it, which is the foundation of syllogistic inference: secondly, that if all the consequences are held to be true, the reason must be true; thirdly, that we cannot reject the consequence without rejecting the reason. Hence the mode of proof called *reductio per impossibile*[2].

Logical truth, however, does not communicate to the mind a distinct degree of certainty from that of mathematical. Both are accepted with the highest degree of belief that can be supposed to exist, and are therefore properly termed metaphysical[3]. Physical and moral truths, when confirmed by the strict marks which we shall presently offer as a test of their validity, are accepted with a similar degree of belief, though it is hard to conceive this of so certain a cha-

[1] Usually attributed to Leibnitz, since it first received entire development at his hands; but the principle was long known in the schools prior to his time. [2] Leibnitz (Wolf's Ontologia, § 71), Stachenan (Ontologia, §§ 23—25), and Degerando (Hist. Comparée, 1 ed. b. i. c. iv.) confound the motive which leads us to believe a thing with the cause of its existence. Now, though there is always a motive, it does not follow that there is a cause for everything. The latter is a pure prejudice of philosophers, from which even Bacon was not exempt. [3] Metaphysical truth is sometimes taken for *absolute* truth, as by Mr. Thompson in his Laws of Thought; but, as we shall presently show, no such thing exists.

racter as that which accompanies metaphysical judgments, inasmuch as the hypothesis of their being false does not lacerate the reasoning principle itself, and has been maintained with great strength of argument by a group of very able philosophers. But moral testimony, which does not bear the assigned marks of validity, or physical events which seem to contradict the usual order of nature, or refer to future results, into the causes of which we are unable to penetrate, must be regarded as probable, but the precise amount of credence with which they must be accepted, will form the chapter of a subsequent book.

CHAPTER IV.

THE FOUNDATIONS OF EVIDENCE.

§ 1.—*Number of Primitive Elements into which all Knowledge can be resolved. Their Relation to each other.*

THE motives which impel us to form those various judgments we have just considered are stated differently by logicians, according to the opinions they have formed on the nature of knowledge. The widest division we have seen is that of Galluppi, who resolves these motives into seven distinct elements; viz., consciousness, memory, external sense, analogy[1], reasoning, evidence (intuitive we suppose he means), and authority; since it is impossible to demonstrate the veracity of any one of these means of knowledge without falling into a *petitio principii*. Thus, when Descartes denied the infallibility of any other primitive fountain of knowledge, unless that solitary act of consciousness which informed him of his own existence, and attempted

[1] For analogy, Galluppi, in conjunction with some other logicians, uses the word induction. May we be allowed to enter our protest against this abuse in applying terms whose functions are already sufficiently large, to designate an entirely distinct class of subjects with which they have no connexion. If this habit proceed much further, all distinctions of philosophical nomenclature will become confounded, and we shall be in the condition of geographers, who, owing to the custom of calling all the places in the New World after the titles of the Old, cannot tell, when an occurrence is said to have happened at Windsor or Halifax, whether it took place in Europe, Australia, or America.

to demonstrate the veracity of the rest, he assumed the infallibility of reasoning and memory, as no truth can be proved without the exercise of these two motives of judgments; and when the scholastics, who were addicted to the folly of demonstrating everything, attempted to prove the veracity of memory by the veracity of God, they fell into as palpable a sophism, inasmuch as the accuracy of the trains of inference they employed depended on the infallibility of the very faculty they were intended to establish.

These motives, however, are so related, that while many of them can be exercised apart from the rest, each requires a separate act of consciousness for the perception of its existence[1]. Thus, we believe in the existence of the external world on the immediate authority of the senses; but these are entirely dependent for their action on the act of consciousness, so that the existence of matter is certified to us mediately through the act of consciousness. Again, no act of memory can be exercised unless through the same medium, and when that faculty assures us of our own identity, consciousness is required as a means by which that act of memory may become manifest to us. But though consciousness[2] thus underlies every other primitive truth, and is essential to their exercise, it has functions apart from them, and, therefore, may be said to have a distinct existence[3]. Thus it reveals to us immediately, and that without the aid of any of the other faculties, the idea of our existence, with that class of intuitive judgments which spring out of the relation between our ideas. It consequently may be said to enjoy a prerogative over the other motives of judgments, as it not only is the direct means of communicating to us a wide class of evidence, but is the grand basement on which the certainty of the other motives rest, the supposition of their invalidity involving in the impeachment of its veracity the destruction of all knowledge.

1 Reid and Royard Collard, following the common-sense doctrine instituted by Père Buffier, erected consciousness into a distinct faculty, even existing separately from perception; but for this they are properly censured by Sir W. Hamilton. 2 The scholastic definition of consciousness, or sensus intimus, is *perceptio qua mens de presenti suo statu admonetur*, and, as such, it is usually taken as synonymous with *conscientia*. 3 The contrary opinion is maintained by Sir W. Hamilton.

It may be observed that each of these means of evidence affords an inlet for original information, except memory, and that its function is simply to reproduce the past states or modifications of the thinking mind. It is not, therefore, an original, but an auxiliary, motive of judgment; but one of so important a character that it ranks next to consciousness in the function of generating knowledge; since, in the absence of its veracity, as we shall presently show, none of the other motives could be of the slightest avail in constructing a system of science. In examining into the nature of the other motives, each will be found to have distinct offices entirely independent of one another, unless, indeed, evidence which, according to our description of consciousness, can have no place in the category, even in the narrow sense of intuition, in which alone its claims could be considered. For the judgments which intuitive evidence embraces are either of a metaphysical character, or they refer to particular coincidences in the external world. In the former case they come immediately under the cognisance of consciousness, and in the latter that of the external senses. Its presence, consequently, in the list leads to a cross division, besides being entirely unnecessary. But as, of the six remaining principles, consciousness never becomes the subject of the direct assaults of scepticism, unless through the medium of the others, we need only inquire in what respect the veracity of these may be placed out of the reach of its attacks.

§ 2.—*Memory an ultimate source of Evidence.*

Without the faculty of remembering the past modifications of our minds, every moment of life would be the first moment for us. We could not recal one experience, or register one single judgment or inference; no science consequently could exist. The only conclusion we could arrive at would be, "I am," and nothing more. Any attempt, therefore, to impugn the veracity of this faculty lays the axe to the root of all knowledge, and even aims at the destruction of personal identity. Sceptics have not neglected to avail themselves of the compendious method thus offered for the destruction of certainty, and have directed their attack in two ways.

First, it is contended that memory is faltering and uncer-

tain, and in many cases has been convicted of deception. Who has not mistaken one object for another, or been fully assured he was in possession of a fact which, when he came to search for it, either eluded his recollection or emerged out of his consciousness in another form? Our courts of justice, and the system of arbitration to which mankind find it necessary to have recourse, hourly present cases of men, each at the instigation of this faculty, making the most conflicting statements, and staking their veracity on the asseveration of an oath. The answer to this objection is patent. We only vindicate the certainty of memory in all those obvious cases in which its certainty cannot deceive us without arguing some degree of mental derangement in the understanding of the person who manifests it. For certainty of memory in such cases is all that is required to legitimate the generation of knowledge, so far as its operation is concerned; but if men choose to tax their memory with burdens beyond its strength, or if they fail to remember things which persons who possess this faculty in any ordinary degree would easily recollect, memory is not on that account to be declared incapable of performing its ordinary functions, otherwise we might argue that because man could not bear a camel's load he was not able to sustain his body erect, or from the fact that there were always a number of valetudinarians, that the human organs were incapable of the performance of their healthy functions.

Another attempt has been made to weaken the evidence of memory, by depriving that faculty of the collateral security which it derives from its connexion with consciousness. For it is contended that consciousness never takes into account the objects of memory, but only of an act existing within us called by that name. But this is a distinction without a difference, for memory is nothing else than the perception of the past modifications of our being: render these illusory, or wipe out their existence from the act of consciousness, and no act of memory can exist. Again, if the testimony of consciousness be veracious, we must admit all that it reveals; but it certifies to us the existence of three distinct faculties, viz., that of the perception of things actually existing; of those which have been and are not; of those which are not and have never been. Now, if the objects of memory had no existence, it would be confounded

with the last faculty, that of simple imagination; or, in other words, it would not exist in the manner in which consciousness reveals its existence to us. We cannot, consequently, admit the separation of the objects of memory from consciousness without impeaching that faculty itself of error.

One of the principal functions of memory undoubtedly is, to assure the consciousness of its individual identity; but as it fails to do this beyond a certain period of existence, it has been pronounced unequal to its mission, and accused of leaving one of the most essential truths without any tangible foundation. For what certainty have we against our existence from eternity in a state of metempsychosis, or that we have not been in the world for three thousand years, and even inhabited the body of a crocodile or a sparrow? All that memory certifies is our existence down to a certain period of time; but with regard to the state in which we existed anterior to that period, as the assumed first months of our infancy, and the nine months' probation in the womb, it says confessedly nothing. It is, consequently, charged with leaving our personal identity uncertain, and, as a reflex consequence of this defect, with rendering all knowledge which is built upon the assumption of this truth, including its own posterior acts, of an apocryphal character.

But this difficulty seems to arise from confounding the functions of a faculty with the remembrance of the exercise of those functions. It does not at all follow that because memory ceases to recal the manner in which it assured consciousness of the identity of *me* in the first moments of existence, that it did not discharge that office. It is a necessary condition of our being that, as we progress in years, the remembrance of infancy become less and less distinct, until we lose sight of its earliest stages altogether; but if we concluded, from the inability to recollect the acts of memory by which our personal identity was revealed to us at the earliest stages of existence, that no such acts took place, we might also for a similar reason affirm the same result of those periods of adolescence whose manner of existence have likewise lapsed out of remembrance. For, in the same manner as we feel assured that consciousness has always accompanied our being from the first dawn of life, though we may not recollect the distinct acts in which it manifested our existence to us, do we believe that memory,

from the earliest stage of being, carried forward the experience of one moment to the next, and thus kept alive the assurance that the percipient soul constituted one identical person. Now, so long as this identity of *me* has been always revealed by memory to our consciousness, whether we remember the distinct acts or not, the link of identity has always been preserved, and the assurance we feel that this condition has been invariably fulfilled, could only be contravened by recalling a moment of existence in which some knowledge of the past was inaccessible to the mind; an act, of course, which is beyond human power. We then are fully authorised to conclude that memory has steadily impressed the existence of *me* upon the intimate sense, and that from two principles. First, that memory itself certifies the fact down to a certain stage of childhood; and secondly, that the amount of sensible experience, which she then assures us we possessed, could spring from no other source than the constant act of memory keeping the identity of *me* constantly before the mind in transferring the experience of one hour to the next[1].

The denial of transmigration, or even the maintenance of personal identity, is not dependent on the argument we have adduced, which, as far as we know, is perfectly novel; but the aid of analogy is called in to assure the individual that what he perceives to be the general law of the human species has not been departed from in his case, and though memory does not expressly guarantee his existence beyond a certain period, or place the possibility of his eternal duration out of court, that the immutability of nature's laws comes to the aid of memory, and proves that his existence could not have passed the limit of a certain time, and that in the interval the identical nature of *me* has been preserved.

[1] With regard to personal identity, it is necessary to distinguish three things, which Locke confounds, viz., memory, consciousness, and the object of memory. Memory is the object of consciousness; the substantial and personal identity of *me* the object of memory. The veracity of both is bound up with the reality of their objects. Personal identity consists in being able to affirm of one past and present existence. Yet Locke makes it consist in the exercise of consciousness, whose only function is to declare the present. See Hum. Under. b. ii. c. xxvii. §§ 9, 10.

§ 3. *External Sense an ultimate Source of Evidence.*

The belief in the existence of matter and its various conformations in the outward world, is derived immediately from the authority of the senses, but mediately is bound up with that of consciousness, as sensation cannot exist without rendering us cognisant of the presence of the object felt. Thus, when we affirm the existence of the desk on which we write, the sense of sight and touch—into which, indeed, vision and all the other senses may be resolved—vouch for the presence of the object in question; but the operation of both of these senses are accompanied by consciousness, which guarantees their reality, and assures us we are not speaking about a mere image or vision, but of a substantial embodiment. The authority of the external senses, as a legitimate motive of judgment, may be, consequently, invalidated by convicting them directly of deception, or by separating either the sensations themselves or the objects about which they are exercised from the domain of consciousness. It was the fate of the ancient sceptics to follow the first course. Their modern representatives have made quite as potent an attack on human certainty by adhering to the second.

The reasons which impugn the authority of the external senses as a certain means of knowledge have received their most elaborate exposition at the hands of Sextus Empiricus, and may thus be summarily expressed[1]. With regard to

[1] Sextus, surnamed Empiricus, from the school of physicists to which he belonged, flourished at the end of the second century. He put the finishing stroke to scepticism, by investing it with the form and method of a science in his three books entitled *Πυρρώνειων ὑποτυπώσεων*. In this celebrated work Sextus defines scepticism as the faculty (*δύναμις*) of comparing the appearances of the senses and thoughts (*φαινόμενα τε καὶ νοούμενα*) with a view to arrive (*διὰ τὴν ἐν τοῖς ἄντικειμένοις πράγμασι καὶ λογοις ἰσοσθένειαν*) at a suspension of all judgment (*έποχὴ*) on objects whose nature is obscure (*ἄδηλον, αφανες*). Hence results a certain repose of the mind (*άταραξία*) and perfect equanimity of disposition (*μετρîοπαθεὶα*). He admits the existence of representations and appearances (*φαινομενα*), and does not deny the possibility of cognition, but the reality of the objects of it. The result of this doctrine was his maxim *οὐδεν μαλλον*, signifying that since

external objects the senses excite different and sometimes opposite sensations in men and animals: That atmosphere

everything was uncertain no one thing was to be preferred to another. His system received a further development in his ten books against the mathematicians (πρὸς τοὺς μαθηματικούς), in the last five of which he sets in a strong light the uncertainty of the principles of those, (Dogmatists) who maintain that absolute truth is accessible to man by affirming it of their doctrines; and denies certainty even to the simplest axioms of geometry and arithmetic. His writings form a complete storehouse of sceptical reasons, and have been pressed into active service by modern sceptics, and by none more zealously than Montaigne. At the commencement of his first treatise (b. i. c. 1, 4) he divides philosophers into three classes, viz., dogmatists, who maintain they have found truth; academics, who affirm that it is impossible to discover it; sceptics, who affirm neither. He repeats the latter distinction in his seventh book against the mathematicians (§ 153). But in one respect it does not hold; since Œnesidemus, the reviver of the third academy, taught substantially the same sceptical doctrines as himself. The distinction, indeed, had its origin with Cicero (Acad. Quæst. i. 12), who discriminated the opinions of Pyrrho from those of Arcesilaus and Carneades, the founders, in his time, of the second academy: for Pyrrho maintained that the existence of probability and doubt itself was doubtful, while these philosophers held that though everything was uncertain, still there was such a thing as probable knowledge, into which it was wise to inquire. They divided probable judgments into three distinct classes: πιθανὴ φαντασία, ἀπέρηισπαστός and διεξωδευμένη ἢ περιωδευμένη φαντασία (Cic. Ac. Quæst. ii. 9, 31, sqq. Sext. Adv. Math. vii. 159, sqq. 161, 167. Euseb. præpar. Evang. xiv. 7, sqq.). The doctrine of doubt, or absolute suspension of judgment, which the followers of the third academy maintained, did not, however, originate with Pyrrho, but with the sophist Protagoras, who flourished about the Ninety-second Olympiad, or 460 years before Christ, which places him nearly a century in advance of his more famous disciple. Of course there is nothing in the mere name of academician to denote a distinct species of opinions, as obtains in that of dogmatists and sceptics, since the word, as is well known, originated with the name of the owner of the gardens near the gates of Athens, who bequeathed his beautiful property to Plato as a convenient spot for the delivery of his philosophical lectures. The distinction, therefore, cannot be introduced into philosophy without a cross division. For the founders of the first academy were undoubted dogmatists, though they taught opinion which legitimately developed their own thesis, and led to the destruction of the universal doubt which followed; while the revivers of the last academy were complete sceptics. The correct division of ancient philosophical opinions would be that of dogmatism, probabilism, and scepticism. Of the latter it is singular to observe the exact resemblance in the general outline of its principles and methods to the Hegelian system, at present so widely prevalent in Germany.

which is dark to man is perfectly luminous to bats and owls. They also excite different impressions in the same individual at different ages, and change the appearance of the objects which they represent in proportion to the variations of distance, and awake different images according as they are viewed through different media. The senses, therefore, cannot convey to us any certain information respecting the objects whose existence they seem to testify; and the assumption of their competency to that end, on which all physical science is reared, is a delusion.

But this objection can only be urged with consistency against those who maintain that the absolute nature of sensible objects is attainable by man—a vulgar error adopted by the first philosophers of Greece; but it does not invalidate one tittle of our belief in the certainty of experience which constitutes the basis of physical science, since it leaves its three fundamental corner stones untouched: 1st. That our sensations are real modifications of our beings: 2ndly. That they instruct us as to the existence of external objects: 3rdly. That these objects have some relations with us—or, in other words, that they appear such as they appear, and excite in us sensations corresponding to the functions we fulfil with regard to the healthy preservation of our being. Now physical science demands the concession of no further principle than is involved in these truths, to show apodictically the relation which must exist between the objects which produce these different sensations as they are conceived by our consciousness. With regard to the absolute nature of the objects themselves, whether they reveal to us the actual essence of things as viewed by superior intelligences, or excite impressions merely relative to the important ends which man has been destined to fulfil in creation, science in reality pronounces nothing.

The observation appears to have escaped this school of philosophers, that men, notwithstanding the different varieties of sensations, generally contrive to perceive the same relations between their sensations. Thus, whatever may be the nature of crystal and light, all perceive the same relation between crystallised bodies and the illuminating medium. This uniformity of judgment about the relation of sensible objects is amply sufficient to guarantee the inference of the

laws which spring from this source, and connecting their phenomena with rational truth to erect the superstructure of physical science.

Again, if the argument of the sceptics be worth anything, it places beyond doubt the existence of two facts—viz., that there are as many different ways of perceiving nature as there are different species of beings and organisations, and, moreover, that these have as many distinct ways of acting as there are different states of the subject on which they act. Instead, therefore, of proving there is nothing certain, it really establishes an important truth. In attempting to convict its opponents' principles of imposture, it destroys itself. So true is the saying of Pascal, that there is a force of truth invincible to every scepticism, an independence of demonstration invincible to every dogmatism.

The sceptics say we are ignorant of things absolutely, and can only pretend to an acquaintance with their relative nature. But it is absurd to affirm that we know things relatively without being cognisant of the terms of the relations. The very idea of a body existing in a certain mode postulates the existence of four things—viz., existence; existence of a thing distinct from *me;* the existence in *me* of certain sensations produced by a thing distinct from *me;* and that this thing is the cause, and is able to be the cause of these sensations. So far, therefore, from destroying certainty by such an argument, the sceptics really establish the theory they intend to overthrow. They find themselves in the position of a class of animals whose instinct leads them to seek the destruction of certain insects by performing the very act which is essential to their preservation.

The objections which a modern school of philosophers have urged against the testimony of sense, with respect to the existence of an external world, have taken their rise in some theories of perception, which it will be necessary to explain and confute before we can place their nature in a true light, or be well satisfied we have escaped from the hard necessity of affirming that space and all the worlds which it contains, together with "this great globe itself, its cloud-capped towers, and gorgeous palaces, are but the splendid fabric of a vision," of no substantial reality, and merely existing in the mind as subjective states arising out of the pre-esta-

blished mechanism of its own nature. It has from time almost immemorial been a belief that the human mind, being a spiritual substance, was not cognisant of external objects directly, but through the medium of certain spectra (species), which by an action analogous to luminous bodies conveyed the exact impress of the material substances which cast them off through the external senses into the mind. From this opinion no moderns presumed to dissent until a very recent period[1]; and even Descartes, in citing every opinion of antiquity before the bar of reason to show cause why it should not be consigned to the category of doubt, allowed this opinion to maintain its place, with one important modification, that "idea should be assumed in place of spectra as the intermediate agent by which external objects were impressed upon the mind[2]." It was contended, however, that the presence of such ideas in the mind could not be assumed as certain evidence of the real existence of the external objects to which they refer, as they only arose out of certain modifications of the percipient being, and consciousness did not warrant us to conclude the existence of anything beyond them. A chasm was thus interposed between the existence of the internal states of our consciousness and the material world, which philosophers attempted to bridge over, by calling to their assistance the veracity of God[3]; or by ingenious theories, either about seeing all things in the divine nature[4], or concerning a pre-established harmony between our internal states and the objective world to which they refer, each, however, acting independent of the other, and solely dependent for their mutual correspondence on the divine will[5]. Such opinions, of course, together with the hypothesis of perception, from which they flowed, reduced the naked testimony of the external senses at best to a probable character, and opened

[1] In this part of the world Reid has the credit of being the first philosopher to call the principle into question, but he got the proof of its invalidity, at least as he represented it, from Père Buffier, and Père Buffier obtained it from Arnauld. See the treatise of the latter, Des Idées Vrais et Fausses, contre ce qu'enseigne l'auteur de la recherche de la vérité. Cologne, 1683. [2] Genovesi thus very accurately expresses Descartes's doctrine: Id quod fit menti præsens dum percipit aut cogitat, quodque semper rei a mente distinctæ, et quidem aut existentis, aut possibilis imago quædam est. Genovesi (Logica Critica, lib. ii. cap. 1). [3] Descartes. [4] Malebranche. [5] Leibnitz.

a breach for the sceptic to renew his attack[1] upon the domain of certainty, in a quarter that Sextus Empiricus little dreamt of trying the strength of, and with far better vantage ground than that from which he had commenced his attack. What Sextus and Œnesidemus did for the probabilities of Carneades[2], Hume and Condillac effected for the probabilities of Descartes and Locke. They showed that in consistency with their own principles no such thing as matter could exist; and that with their postulates in the background even the reality of the appearances themselves might be validly called in question. But that the principle itself is a true theory of perception we have no other proof than the very slender one, of the consentaneous belief of nearly all philosophers up to a very recent date in its veracity. Of itself, it is supported by no intrinsic grounds whatever. For even admitting its truth, it does not lessen the difficulties it was called in to resolve, since it is quite as hard to understand how external objects can generate spiritual ideas, as it is to conceive their direct action on a thinking substance. If matter be declared incapable of the latter, it is doubly so of the former; and Berkeley, Hume, and Condillac were perfectly justified with such a theory in their heads in wiping out the external world altogether.

Moreover, this hypothesis has been introduced not only without an object, but in total defiance of the revelations of consciousness. If that principle can be said to assure us of anything, it certainly is the existence of things external to us by the sensations they excite in the mind; and all men, even including those who pretend to disbelieve it, act as if the testimony was of an infallible character. The assumption of the contrary doctrine is so contrary to the common sense of mankind that it requires some advance in philosophy to entertain it. It involves the supposition that perception can exist without the reality of the object perceived, which seems a contradiction in terms. The opposition of this theory to the plainest instincts of consciousness may be further seen from the fact that it is at strife with the idea that we have

[1] As Descartes, Wolf, Malebranche, and even Locke, who adopted Descartes's views on the subject maintained. See Hum. Under. b. iv. § 3. [2] εὐλογιστιά.

of sensation as a phenomenon, whose cause is identical with the object which produces it. Now, sensation offers itself to the consciousness as distinct from the object felt and the subject which feels, being essentially connected with both. It manifests itself as an effect of the same object felt; not being able to refute the testimony of consciousness, we cannot deny the objectivity of the sensation, and consequently the existence of the body. Again: if we have a conception of a body that is not present to our senses, that conception must refer to this object solely as an object conceived, but not as the cause of the conception. The absence of this double relation of a conception to the same object converts the act into one of pure imagination. We consequently cannot deny the presence of a body actually modifying our spirit in a case of sensible perception, without confounding that act with the operation of the imaginative faculty; and thus again convicting consciousness of imposture in blending two acts, which it assures us are perfectly distinct.

It is urged, however, that dreams manifest cases analogous to those of sensible objects, even when no external agents exist answering to the images excited in our mind. But, in the first place, it may be replied that such impressions exist as simple objects of the imagination, which are put to flight as soon as consciousness awakes us to the real appearance of things. We do not embrace them with anything like the same degree of certainty as the objects of the waking senses, nor move our bodily organs to correspond with the illusions they excite in us in the same manner as we dispose our actions to suit the direct impressions of the sensible world. In such states we are incapable of reflex acts of thought; that is, we are never able to distinguish between appearances and realities, and the first moment in which we feel inclined to question the reality of the impressions in the sensorium we are roused into a waking state and feel assured of the delusion. That dreams owe their origin to the imaginative faculty must be admitted, from the circumstance that the images which they excite in us do not occur in the same order in which they exist in nature, but arise capriciously out of past modifications of the mind, which the fancy sets together in the most ill-sorted and fantastic manner, in sport, as it were, with the solemn realities and conventionalisms of nature and society. That we appear to accord to her pranks any semblance of belief arises

from the attention of consciousness being entirely withdrawn from the real world and fixed upon such representations of it that imagination chooses to give, to the entire abstraction of everything else; but that consciousness accords entire belief to such representations on that account is no more to be inferred than that of a reader's assent to the truth of a tale which entirely absorbs his attention, or that of a woman's belief in the real characters of the mythic personages of a theatre because she swooned away at the finale of the play. The only difference in these cases is the minor degree in which consciousness is abstracted from surrounding objects, which consequently leaves less play for the exercise of pure imagination—a modification which is also displayed in dreams themselves, since some appear less real than others, while there are others which accompany a half-waking state, whose illusion is manifest from the commencement of the operation.

Again, the sensations excited by dreams never convey a new class of objects into the mind, but simply reproduce the old, and that according to the strength of the impression by which those objects have been previously communicated to the mind, or the number of times it has experienced their presence. Hence, hounds in their sleep open for their prey, but no other class of the canine species do, because they have never hunted in their waking state: an orator who has controlled the decisions of senates, or a general who has commanded armies, imagine they hear in their sleep the murmur of applause or the thunder of cannon; but a ploughman or a huckster never finds himself in the same predicament, simply because he has never mounted either a breach or a tribune. This principle is undeniable, being attested by every one's experience. If, therefore, nothing enters the mind in dreams but what has been there in some shape or other in its waking state, these delusions, instead of weakening our belief in the existence of external bodies, really establish it; or, in other words, they show the impression of the existence to have been so strong as to act when the object which originally produced it has passed away.

All the errors which have been propagated on the testimony of external sense have sprung out of the supposition that the veracity of consciousness can stand without the veracity of the other media of knowledge; but we have shown, at least as far as two are concerned, that it assures us of their particular

existence both as to the relation of the exercise of the act and the object, and therefore cannot be isolated from them. This truth is further strengthened by the illogical consequences in which its contradictory has landed its opponents: for while Père Buffier, with Reid, formed the veracity of external sense on the common sense of mankind as distinct from consciousness, they fell into a palpable *petitio principii;* since they had previously assumed the universality of the belief, as a mark of such testimony being a primitive truth. Or, in other words, they first lay down the postulate that every truth which is universally received is primitive, and must be received on its own evidence; and then show the testimony of the external senses is such, by affirming of it the very characteristic which they ought to have proved[1]. Though the Cartesians avoided this paralogism, by resting the veracity of the senses on the veracity of God whose existence they placed in the idea we have of the infinite, still they were guilty of the inconsistency of affirming that consciousness was competent to certify the presence of that idea, while it was unable to assure us of the existence of finite bodies out of which such idea may be said to spring. If, however, consciousness may be said to warrant us in assuming anything, it is that external things are not only the cause of our sensations, but the objects we perceive along with our sensation; or, in other words, that our sensations are not only passive modifications, but the immediate perceptions of things outside of us, and we cannot invalidate such testimony without impugning its veracity, and even calling into doubt our own existence[2].

§ 4.—*Analogy an ultimate Source of Evidence.*

Consciousness and the external senses only make us acquainted with particular facts. But physical science can-

[1] Père Buffier gives two other marks of primitive truth besides the one in the text, viz.: The incapability they manifest of being established by truths clearer than themselves; 2nd. That those who cavil with them act upon the belief of their existence. See l'Essai sur les vérités primitives, c. 3—5. The gross instance of the fallacy in the text reminds us of the common reply of the farmer when we ask him why we may not ride over his field: "Why—why—why that's the reason why." [2] For the consideration of spectral illusions, as bearing on this subject, the reader is referred to the supplement of this book in the Appendix.

not draw any certain inference from them without a belief in certain axioms: such as the stability of the course of nature; that individuals similar in their apparent qualities are similar in their occult qualities; that similar effects proceed from similar causes, and other principles of the same import, which, as they spring from an interior conviction of our nature that the future will resemble the past, are designated by the common term analogy[1]. As this principle is the foundation of all our knowledge of nature, any attempt to overset it must be viewed as a direct attack upon the existence of the external world, and, therefore, must be met before we attempt to expound the leading inferential forms by which its laws are established.

But beyond the objections whose confutation we have already attempted[2], we meet with no direct assault upon this principle, unless from the solitary pen of Hume, who contended that the principle of analogy could not be maintained without falling into the sophism so often adverted to. For it is impossible to affirm a likeness between two things, one of which we have never seen or heard of. We ought, therefore, to know the future in order to compare it with the present; and the assumption of this knowledge, which is required to be proved, is the only foundation on which analogy rests. But this argument supposes that analogy is an experimental truth, which Hume affirms it must be, if it be any truth at all, since it is obviously neither necessary or identical. The confusion, however, lurks in the word necessary. It is not necessary, as we have already shown, in the sense of the highest metaphysical truth, that is, independent of all condition; but it is necessary in the supposition that it does not depend upon experience, but has been blended with the primordial elements of the mind with a view to guide its inferences with respect to the objects which envelope and surround its being. In this sense the

[1] We have shown in a former chapter we do not derive these axioms from experience but from an instinct which precedes or is co-existent with experience. The establishment of this truth shows that inductive inference does not differ from demonstrative in the threefold character of the judgments involved in its illation. [2] Of course those who refuse to admit the testimony of sense as a certain motive of judgment, place analogy in the same category as Wolf. Logica, p. 2, §§ 674, 677.

word necessary is sufficient to raise it out of the category of experimental truth, and rescue it from the objection which is only brought against it as belonging to that category.

But even on the ground of its being an experimental truth, we think the view of this illustrious sceptic cannot be maintained. For it is undoubtedly in our power to regard every moment of existence as future in relation to the first instant which memory can recal, and every subsequent moment as past relative to the objects which succeeded it, and future with regard to the moments already past. Thus every instant, unless the first, may be regarded as either past or future, and running over these several moments we may perceive that the course of nature has invariably presented the future like the past, and from the comparison are entitled to infer that it always will continue to do so, without the illogical consequence which Hume attributed to such an illation.

It may be important to observe, that the analogy produced by certain knowledge is not to be confounded with conjecture[1]. For though intellectual superiority consists, in some degree, of the skill which is exhibited in employing the experience of the past to foresee the future, yet the results are never more than probable, as the will of man and the capricious nature of human events, which refuse to submit themselves to the calculations of the exact sciences, are liable to defeat the wisest prognostications. The astronomer, foreseeing with certainty what will be the future relations of celestial phenomena in a given time, is able to determine the exact moment of the equinoxes, and predict lunar and solar eclipses; because a constant experience manifests to him the laws of the motions of the heavenly bodies, and mathematical knowledge applied to observation gives him infallible results. But if he turn his horoscope on the future of society, both the vacillating nature of the will and the ignorance of the motives which determine its action in any weighty crises, the sudden appearance of great men on the scene, who unexpectedly found, overset, or remodel religious governments and dynasties, prevent anything further than

[1] Dugald Stewart appears to us to fall into this error. See Phil. Mind, a. 3, § v. c. 2.

probability even in predictions which fall within our own time; while with regard to those which extend beyond it, even probability, in some respects, is unattainable. If the arms of the republic had been victorious at Filippi, what would have been the future of Rome? If Bonaparte's father had not married a Corsican, and thus brought that general into the world, what would have been the condition of France now?

§ 5.—*Reason an ultimate Source of Evidence.*

Another primitive motive of belief is reasoning, or the necessity we feel in any legitimate argument of admitting the conclusion when we have conceded the premises. The legitimacy of such a motive cannot be proved without assuming the thing in dispute, and even those who deny its authority can only make out their case by an appeal to the authority which they call in question. Sextus Empiricus, however, attacked the veracity of reasoning: first, on the ground that the majority of men who employ its methods come to different conclusions; and, secondly, that since it is impossible to prove everything, the whole structure of inference rests upon assumed principles, and partakes of the uncertain character of their foundation. The first argument is logically vicious, as the conclusion contains an illation more universal than the premiss, being tantamount to this: "Some men have reasoned badly, therefore none can reason correctly:" but as all men who reason admit the veracity of the means of knowing, why does not their united agreement in some particulars coerce the sceptics into the admission of some truth, if the discrepancy of opinion which men manifest furnish them with a motive for suspending their judgment? Even if the inference be granted it is at the expense of a double inconsistency.

From the premiss of their second argument, that all truth is incapable of being demonstrated, it does not at all follow that no inference is certain, but points to a totally opposite conclusion. That all the layers of stone which an edifice comprises are not indented into corresponding layers beneath them, but that the first pile rests upon solid rock, if it go to establish anything, it surely is the security of the building so situate. Now on such solid rock repose primitive

truths, for they are vouched for by the direct evidence of consciousness, than which there can be no higher security in nature. But the sceptics seem to forget, in urging such objections; they suppose the authority of reason in the act of destroying it, and thus commit palpable suicide on their own principles. They are in the position of the woodman who was so busy in felling the branches of a tree, that he cut off the very bough on which he was standing[1].

§ 6.—*Authority an ultimate Source of Evidence.*

As man is unable to exist in all times and places, or to assure himself of the certainty of every link of evidence which demands his attention, he cannot avoid resting his belief on the authority of others if he would travel beyond personal experience, and in fact does so with a confidence not less certain than he accepts the evidence of his senses. This certainty, which is termed moral, has been attributed to analogy[2], as we may be said to infer a thing will be true under certain circumstances, which has always proved so when the marks which attended its veracity has been fulfilled. Thus, we have heard that there is such a place as Egypt; by subsequent travel we realise the truth of the testimony by which we were led to believe in its existence. We read of the demonstrations by which Newton proved that the inequalities of lunar motion was a consequence of the universal law of force, and though we may not have examined the consecutive train of inference by which that fact was established, we do not believe it with less certainty, from having proved the correctness of similar testimony when we applied the test of personal examination.

Though authority may, as a motive of judgment, derive collateral support from such confirmations, we hardly think the main trunk of its certainty springs from other ground

[1] Hegel assumes the principle of contradiction, or that everything has its opposite, which Œnesidemus taught in the middle of the second century, as valid ground for refuting the conclusions of legitimate inference; but of course it would be perfectly idle to prove against him that one cannot be right and wrong at the same time. [2] By Galluppi, Lezioni di Logica, 32. Locke on this account would allow no certainty but what sprung out of direct personal experience.

than that of the direct intuitive evidence of consciousness. For postulating the durability of the laws of human nature, it is quite as impossible to conceive a number of men, separated by gaps of time and dwelling in different hemispheres, who can have no personal interest in affirming the truth of what they state, and no common ground for acting in concert, should conspire to cheat the rest of their species with a lie, as to imagine that two straight lines can enclose a space, or that the whole should be greater than the parts of which it consists. Moreover, the direct pledge of consciousness is required to certify the infallibility of this motive of judgment; as there are many truths resting upon authority whose evidence is past and cannot be repeated, which it is consequently impossible to bring under the cognisance of any existing personal knowledge. We accept these, however, when duly corroborated, with the same unhesitating belief as others, whose truth is hourly confirmed by the evidence of additional personal witnesses, and that for no other reason than the impossibility we intuitively feel of conceiving the testimony of man can be other than true under the circumstances we have supposed above. These conditions may be thus formally stated: 1st. That the testimony be universal. 2nd. That it arise from nature. 3rd. That it be convenient to no sect or class. And 4th. That the testimony when it relate to present facts, increase with knowledge.

Authority has been attacked only in its theological relations, and that by two distinguished sceptics; but the argument of one respects rather the fulfilment of the conditions than the truth of the testimony, which rests upon them. Gibbon states the evangelical account of the death of Christ is not to be received, as it lacks the testimony of cotemporary writers. If that be so, of course the main condition of the veracity of authority has not been fulfilled, and our thesis remains untouched. But Hume boldly assumes the hypothesis of the conditions being carried out, and asserts that even when accompanied by such marks of evidence, authority is not to be trusted, when the report it announces conflicts with the permanence of the laws of nature. But the objection, though urged against the reception of historical testimony in the case of miracles, is really to be met on other grounds. For if a Providence exist who has impressed

those laws on material objects, the assumption that He has suspended their action for His own wise designs, is the only escape we have from the absurd conception that a number of men, who could not possibly act in collusion, should conspire to deceive people with no selfish object in view. But if no Providence exist, and we believe Hume was not disposed to rest his argument on that ground, the assumption that those laws could be suspended without material agency could not, of course, be entertained; and the hypothesis of the marks of the certainty of authority being in that case fulfilled, must fall to the ground. The belief in miracles is thus resolved into the belief in the existence of God. If that be denied, the hypothesis can not hold; if it be acknowledged, it leads to a consequence—it sustains the irrefragable nature of authority, when founded on the unanimous testimony of men.

These six fountains of evidence constitute the criteria of truth in the widest sense. If there be one criterion which exercises any prerogative over the rest answering to the description of Cicero—Insignis illa et propria percipiendi nota propria veri et certi nota[1]—it is reason in its intense and primitive purity[2].

BOOK V.

METHODS OF SCIENTIFIC PROOF AND INVESTIGATION.

PROEMIUM.

Having traced in the foregoing pages the subordinate compartments in which the structure of evidence may be divided, and pointed out the foundations on which the edifice rests, we may now proceed to treat of the general outlines of the building, and show in what manner such of its parts as are dissimilar fit into one another, and form by their union the different branches of science of which the structure is com-

[1] Degerando, Hist. Compar. Syst. Phil. b. ii. part ii. c. 4, pronounces such criterion impossible, as indeed it is in the sense in which he takes it, as a certain seal or stamp, whose impress will lead the reader to detect truth without any examination. [2] Ac. Quæst. iv. c. 31, 31.

posed. This, the leading portion of the treatise, though capable of being pursued almost to an indefinite extent[1], easily admits of being brought within the limits we have assigned to it, as the only two divisions of the sciences whose methods are so radically distinct as to require separate treatment, are the moral and the physical; and the methods, which each of the various sciences comprised in these two groups embrace, are so homogeneous, as to be disposed of in five or six sections. For the sciences, included under the physical branch of the division, do not exact specific methods varying with every subject-matter about which each is conversant but with the precise stage of development at which they may have arrived. They commence with the registry of simple facts and collections of instances, and from thence ascend to the most universal laws or axioms, through the medium of intermediate ranges of laws, gradually widening into them; while the moral sciences, for the most part, embrace the reverse process of descent from axioms of the widest generality, through cases of gradually diminishing extent to the minutest particulars. The methods entered upon at each of these stages are adapted to the further development of all the sciences which have reached them; but since the same method by which a law of minor generality has been connected with a multitude of particular facts, either by the deductive or inductive mode of inference, can be of no avail in connecting such minor law with one of wider generality; it is evident that, as the growth of sciences varies, the method by which they are investigated must vary along with them. In the physical sciences, however, this development may be included in three stages, viz., the descriptive, the inductive, commonly called the experimental, and the deductive or exact stage; the first corresponding to the position which meteorology, and the second to that which chemistry and crystalography at present occupies; while astronomy and mechanics may be taken as examples of the third. The methods by which any physical science is forwarded through its first stage may be comprised under the head of observation, experiment, classification, and nomenclature; these lead to the

[1] And for that reason, *i. e.* its seeming vagueness, probably hitherto neglected in logical treatises.

discovery of proximate causes, and laws of the lowest degree of generality, through the application of the canons of experimental inquiry. The latter, consequently, form the methods applicable at the second stage; while, as a science, is made deductive by the formation of theories, and by bringing these to the test of quantitative laws, the nature and use of hypothesis, with the functions that mathematics play in the verification and construction of the exact sciences, will comprise the last range of methods which enter into the highest development of physics. To the complete explanation of these different methods, it is essential that some account be rendered of the general laws they are designed to discover, both in their simple and complex states; and to this end we shall add a section to each of these tripartite range of methods, explanatory of the nature of the facts and laws they are intended to bring to light, how each are interwoven and fit into the universe of things, and the general entanglement from which they are to be disembedded. But as many events occur, or facts present themselves, even in the physical world, whose laws, if they are amenable to any, we cannot exactly ascertain, one of these sections will be devoted to the exposition of the general characteristics by which such facts or events are accompanied, and the methods pursued to construct out of them general propositions, available either for scientific purposes or for practical utility. Hence this part of the book will embrace six sections, three comprising the various methods pursued in the construction of the sciences, and the remaining half generalising the multitudinous cases of phenomena with which those methods have to deal.

The methods which the moral sciences embody are, in many respects, identical with those already described, the only points in which they much differ being the deduction of individual laws and occurrences from abstract propositions, which we obtain from other sources than experience; and the dealing with multitudes rather than with individuals, in order to neutralise as much as possible the uncertain element introduced into these sciences by the action of the human will. The complexity involved in mental, spiritual, and social phenomena, demand more subtle agencies to trace their laws than those which obtain in the material world;

for, while the principles of the one seem eternal and immutable, those of the other are ever shifting with the current of the hour, and continue to exhibit fresh phases at every stage of their development. Hence one or two direct modes of inference are inadequate to grasp the perpetually changing nature of the phenomena they present; multiplied and diverging lines of argument are required, such as those included in the negative process and the cross-examining elenches, whose functions in moral proof are precisely analogous to those which the calculus performs in the physical sciences. The explanation of these methods in conjunction with the purely deductive sciences to which they are applied, as theology and ethics, will constitute one section, while their connexion with the mixed or inverse deductive sciences, as politics or ethology, where empirical data are blended with *à priori* principles, will comprise another. In connecting such empirical facts with minor or general principles, either by way of direct proof or verification, the canons of experimental inquiry will be found directly available where the nature of the phenomena requires us to proceed by the path of induction; but in the case of analogy and approximate generalisations, a distinct section will be required, on account of the shifting nature of the evidence and the influence in much of the data of the capricious element of human volition. It will be observed that the methods in this arm of the division are more irregular in their application than those belonging to the physical branch; since, instead of varying simply with the growth of the sciences, they adapt their form to the specific matter with which each is conversant. As the subjects, however, which they embrace are not of so multiform a character, the methods are capable of being included within less limits than those of the physical sciences, embracing only the three sections we have assigned them, an additional one however being added, by way of preliminary exposition of the nature of liberty and necessity, and the general objects, about which it is the province of the subsequent sections to treat.

CHAPTER I.

METHODS OF THE PHYSICAL SCIENCES.

§ 1.—*The Nature, Grounds, and Limits of Physical Investigation.*

THE object of the inductive sciences may be said to be the pointing out what uniformities are perpetually occurring in nature, and placing in evidence the causes or laws upon which their existence depend. We hear, for instance, a sound when a musical chord is struck, and on instituting an inquiry into the cause of the phenomena, find it to consist in the communication of motion from the sounding body to the adjoining particles of the air, and the propagation of motion from particle to particle of such intermedium till it reach those contiguous to the ear, which convey the impression to the auditory nerves, and from thence to the brain. The investigation, however, does not terminate in extricating the ultimate cause of the phenomena, but merely presents us with simpler causes, into which its complexity may be resolved, viz., the cause of motion and sensation. Though we have no infallible proof that the latter causes are ultimate, and indeed strong presumptive evidence that they are complex phenomena, it is usual to place them in the former category, at least until science enables us to complete the analysis of the parts into which they are capable of being resolved. Whether ultimate causes or laws are attainable by the methods upon which science relies for its most successful prosecution, or whether man's faculties are too gross to discern them in the undiscernible molecules and corpuscular motions in which they may be supposed to reside, it is not for man, in the present state of science, to hazard an assertion. Suffice it to say, that those properties which appear ultimate, such as the gravity of matter, the mutual attractions and repulsions of its particles, the equal pressure of liquids in all directions, are generally considered in the light of original causes, while the uniformities into which these enter as active agents are ordinarily regarded as derivative ones. For example, the rise of mercury in the Torricellian tube is nothing more than an in-

stance of pressure on a fluid in one direction unopposed by an equal pressure in the contrary direction, producing motion which does not cease till equilibrium is restored. But the uniformity in question is regarded as derivative, since it is fully accounted for by the weight of the air acting on a body which distributes the pressure communicated to it throughout all its parts with equal intensity. Hence the variations of mercury in the barometer in proportion to the density of the atmosphere may be said to take place according to a derivative law, while the two laws in which it eventuates may be considered as ultimate, until we are able to disentangle the skein of causes which compose their results, and estimate their effects in like manner.

As complex uniformities, like the instances we have adduced, are virtually implied in the simpler ones of which they are the spontaneous effects, and consequently do not require a separate act of creative will to necessitate their existence, the designation of laws of nature has been denied them by an acute writer[1], who seems disposed to restrict the term to those laws which do not admit of subordinate analysis. But the statement is upheld in the absence of a distinction which is essential to the subject, as going to the bottom of the dispute about the nature of the causes and laws which it is the function of scientific methods to discover. For it is evident that laws may be considered ultimate with respect to the bodies through which they manifest their agency, which are, however, not the less resolvable into the simpler elements or laws out of which the substance arises whose properties they constitute. Thus, the cohesion and capillarity of the parts of liquids perish when they are resolved into the expansible fluids out of whose combination they sprung; but it is nevertheless certain that such cohesion arose from the increased attraction with which the union of the elementary gases invested the minute particles of which the resulting liquid was composed. Or, assuming the reverse case of the conversion of an inexpansible fluid into a solid—a process of continual occurrence in the animal system;—as the liquid approaches a viscid state, mobility among its parts, or the law of the propagation of equal

[1] Mill's Logic, vol. i. p. 383. In the example which he gives he is peculiarly unfortunate, his third ultimate uniformity, as we instance in the text, being only a corollary of the second.

pressure in all directions, gradually disappear, though there cannot be the slightest doubt that the change is effected by neutralising the peculiar combination of attractive and repulsive properties which constitute the laws into which that mobility may be resolved. Now, to grant that those laws which are only ultimate in the extreme sense are solely entitled to be regarded as laws of nature, would be to invalidate even the claims of those to that designation which form the boundary of the present state of scientific analysis, for there are none so simple which chemistry does not promise to resolve into more elementary laws; while the concession of ultimative properties in the relative sense would not afford any ground for the theory that such only can be justly termed laws of nature, as requiring a separate fiat of creative will; since such laws arise out of mere combinations of ulterior properties, which can be supposed to occur as spontaneously as the combinations which give rise to derivative laws into which they enter, without any specific interference on the part of the ruler of the universe.

In reality with regard to absolute primordial elements nothing is known, and the introduction of the terms ultimate and derivative can only be accepted to distinguish those laws whose elements are known from others whose causes lie concealed. But notwithstanding the inquiries which it is the object of physical science to institute into the laws of the material universe, at best only conduct to the proximate causes of things, they for the most part point out the nature of their various properties, and frequently reveal the ingredients of the substances of which they are composed. This leads to a twofold division of laws really pertinent to their nature, one as regards the action of substances, the other referring to the elements which enter into their composition. Thus it is a law or immutable condition of nature that if two-thirds in volume of hydrogen be brought in close contact with one-third of oxygen while the two gases are in an electrified state, water will be produced; or that if silica, alumina, soda, sulphur, and a trace of iron be combined in certain proportions the result will appear in the creation of lapis lazuli; just as much as it is a law that planets move in ellipses round the sun, each describing equal areas in equal times, or that in their orbits the squares of the periodical times are proportional to the cubes of the dis-

tances; although we know in the latter case that these different properties of planetary motion are resolvable into laws still more general, which may be in turn deduced from the peculiar combination of centripetal and tangential force in which they originate, while we are as certain that in the former the proximate substances of which water and ultramarine-blue have been shown to consist admit of resolution through different stages of more elementary substances into the simplest results that chemistry has laid open to us. The causes, therefore, which scientific methods seek to discover, always imply laws, since they exist through their agency; but laws cannot be regarded without some laxity in the use of language as synonymous with causes, unless when in addition to the signification of the measure of the forces by which other substances and properties act, they generate new substances and new properties, or in other words new laws. But the web of cause and effect is so intricately blended in nature, that we know of no existing law which does not produce, and may not be consequently deemed the cause of its effect, so that philosophers are conjointly agreed in viewing the two terms as interchangeable in the language of natural science. The elliptical motion of a planet, for instance, though the final result of certain elementary forces, is one of the principal conditions on which the return of the seasons depend, and the periodical succession of the seasons is again an essential element in the production and renovation of the internal economy of the planet.

The causes, then, whose discovery forms the object of scientific pursuit, may be assumed to be the essential physical conditions, or material agencies, on which the different uniformities in nature invariably depend, whether such agency be the derivative effect of original self-acting agents, as is the notion of the development theory both in its ancient and modern aspects, or are ultimate agencies themselves, or the result of ultimate agencies created and set in action by the direct fiat of God, as is the Theistical doctrine. Of the original agents, and the primary forces into which the whole phenomena of the material universe may be resolved, science takes no direct cognisance, unless through the medium of the derivative and intermediate causes, whose action is capable of sensible analysis. Whether such agents exist, or are appreciable by the human faculties, science takes no

account. Attempts have been made to grasp them at an earlier period of the earth, by seizing upon some vague assumption as the radical element of all things, and seeking to evolve out of it the constituent furniture of the universe. But such efforts, beyond originating in casual discoveries of trifling importance, have recoiled upon their promoters, and left science, even after the toil of ages, much in the condition of the stone of Sysiphus, with no ulterior prospect of advancement. Warned by the futility of such efforts, modern inquirers are content to take such truths as the analysis of sensible phenomena offers, being convinced that if remote or primary elements exist, the only path by which they are attainable lies through the proximate causes which express their complex results; and as the investigation of these afford ample room and verge for the employment of their highest faculties and the augmentation of their dominion over nature, they concentrate their attention on their discovery with the assurance that if such proximate causes do not conduct to primary elements, that the pursuit of ultimate causes is hopeless. Accordingly, astronomers do not seek to discover the origin of the planetary movements in the application of a determinate projectile force in a determinate direction, but take such force as already existing, and endeavour to follow it out into its results, and trace its laws, or the causes of its different combinations. In like manner, philosophical chemists no more aim at determining the one essential element out of which all matter is framed, than sober geologists attempt to infer the origin of our system, or the condition of the earth at Creation from the present collocations of strata which compose its crust. The discoveries, it is true, in these sciences, which the steady adhesion to philosophic methods is constantly bringing to light, are ever tending in this direction, but this approach, like that of the asymptotes, may have a limit, and never reach its object, though constantly approximating to it. On account of this direct tendency of scientific discoveries to simplify the multifarious uniformities existing throughout nature, and trace them through a gradually diminishing series of subordinate uniformities to the fewest simplest uniformities cognisable by the human faculties, the problem which the scientific methods are intended to resolve may be stated to be—what are the fewest general elements into

which the existing uniformities of nature may be resolved, and what are the laws which guide such elements into their complex results, and necessitate their existing collocations?

As a preliminary step towards the solution of such problem, it is important to remember that the grounds on which the inquiry proceeds are independent of experience, though all the subsequent processes are either determined by the results of experience or are amenable to them by way of verification. We cannot help believing that certain properties which we have once perceived to accompany certain substances will invariably accompany them, and that the connexion between them has existed since such substances came into being. We believe that wood will burn a century hence if fire be applied to it, just as we believe it burned some four thousand years ago in Assyria, or as we believe it burns today in Cochin China under similar circumstances. This class of uniformities comprise the first spontaneous inductions which the philosopher is obliged to accept, in common with the child and the peasant[1], as the groundwork of his reasonings, and to employ them in the commencement as guiding marks by which he may be led to discover the unknown uniformities which exist in nature. To attempt their proof would involve him in what logicians call a vicious circle; just as much as if he were to demonstrate any other primitive truth, since he could not establish their cogency without the medium of the truths already built upon the assumption of their correctness. Were such inductions referable to mere experience it is obvious they must wax strong by repetition, and be consequently weaker in the child than in the adult, and obtain greater credence now than in the infancy of the world. But all that we know of our progressive state, and those of our species, is in conflict with such a supposition. A child believes that flour will continue to whiten and water to wet any substance with which they are brought into contact, when it has once experienced such effects, as firmly as it does

[1] We are reminded of an apposite passage in Shakspeare, which our readers will not blame us for quoting:

TOUCHSTONE. Hast any philosophy in thee, shepherd?

CORIN. No more than that I know that the property of rain is to wet, and fire to burn; that good pasture makes fat sheep, and that a great cause of the night is lack of the sun.

TOUCHSTONE. Such a one is a natural philosopher.

As You Like It, Act iii. Sc. ii.

after a hundred thousand repetitions of the same impression; nor have we any reason to believe that the faith of the ancients in the permanence of similar uniformities was inferior to our own[1].

But whence comes it that credence in the permanent nature of such phenomena is confined to a special class, and that many qualities exist which the mind never expects to find invariably concomitant with the substances in connexion with which they first meet its gaze? We believe that fire will burn and water will wet, but never expect those objects to maintain the same colour. We should esteem it little less than marvellous if, having once tasted the effects of bread, we should, on recurring again to that aliment, find it accompanied with the flavour of cinnamon-juice, and the unnutritive properties of deal shavings: after meeting with a green chameleon, however, we should be by no means startled on a renewal of his acquaintance at beholding the same object assume a bluish aspect. How is it that uniformity in one case is never looked for beyond the immediate instance, while in the other it is expected to occur at every repetition of the object? That some principle is at work beside mere experience is evident from the fact, that however invariably some properties may accompany certain objects, we never place sufficient reliance on the uniformity to generalise such

[1] Some may be disposed to quote the ode of Horace, ending with

Damnosa quid non imminuit dies?
Ætas parentum, pejor avis, tulit
Nos nequiores, mox daturos
Progeniem vitiosiorem.—Lib. iii. c. 6.

against the statement in the text, but the allusions of the bard simply refer to a gradual paralysis of the powers of nature becoming effete with age, and not to any capricious interchange of properties on the part of the natural elements, which would invalidate our confidence in the constancy of their effects. If the substances in nature decay, their properties of course perish with them; but no ancient of sane mind ever doubted for a moment that while the substances continued in their healthy state, they would manifest other properties than those which his first experience had attributed to them. There is no ultimate principle of our constitution which urges us to believe the universe will always remain as it is; against which the doctrines of Christianity and the tenets of the development theory alike contend; but only that while it does continue, the substances of which it is composed will not manifest different properties than those on which their internal constitution depend.

results or extend them beyond the instances we have experienced; while in others, one single case impels the mind to place no limit to the uniformity, but to make it co-equal with space and time. The solution of the difficulty will be found in the sheer impossibility of the mind to believe that a thing can be otherwise than what it is; or, in other words, that a substance can exist and manifest properties conflicting with those which depend on its internal organisation. Now, no philosophical instruments are required, or, indeed, the slightest process of investigation, to enable us to draw a line in the common elements of nature between those properties of objects which spring from variable external agencies and those which depend on their internal constitution. A child has but to taste bread to feel that the nutritive properties it possesses springs from the peculiar constitution of the several particles of which it consists: it has only to open its eyes to perceive that certain substances may be accompanied with a variety of colours, and thus infer that such quality is not essential to their existence. A crowd of similar accidental and essential uniformities are spontaneously offered by nature; and that written so legibly that the peasant, in common with the philosopher, may read them; the only difference between the two minds being, that the one contents itself with such as nature writes upon her surface, while the other, searching for the crowd of uniformities that lie beneath them, asks what facts are needed to enable it to come to a sure conclusion, and then looks out for these.

As nature may be regarded as an immense web of causes and effects, curiously intertangled and combined, the main difficulty in this research lies in unravelling the various threads, and estimating the influence of each fibre which enters into their composition. If one consequent were only the result of one antecedent, the investigation would be comparatively easy, but in the generality of cases the opposite is the rule, one effect being commonly the product of a variety of causes, the influence of each of which in producing the phenomena in question it is necessary to estimate, if we would come to a certain conclusion about its origin. For instance, in the production of the neap tides there is the influence of the sun, moon, and earth, each neutralising one another's attractive force, over a body which admits of mobility among its parts to such a degree as to move in the

direction of the impulse communicated to it by three distant bodies acting in contrary directions. In ordinary parlance, among the conditions of an effect, one cause is commonly selected to which the result is attributed, either through its being the principal or the culminating agent in its production. Thus, a person in a feeble state of health takes mercury, and exposes himself while in that state to night air; the effect is sudden cold, which is at once ascribed to the influence of the atmosphere, though the result was doubtless as much attributable to the mercury[1] and his weak condition: any statement, therefore, of the cause of the cold which did not include the three antecedent conditions must be considered imperfect. Again, the death of the Duke of Wellington was attributed to the effect of some fruit pie, of which he had voraciously eaten the day preceding his demise, though no one could for a moment doubt that the great agent in the business was a general decay in the digestive organs, which only required the slight temporary derangement produced by the fruit in question to completely incapacitate them for discharging those functions on which life depends. In like manner, a boy rolls a ball which, towards the end of its progress, is stopped by a stone; yet it is very probable that such an event would not have taken place had not the resistance of the air and the counteracting force of the earth's attraction weakened its motion to such a degree as to prevent it overleaping the stone, though the two latter causes are omitted in the account of the phenomenon. When the culminating condition is superficially the most conspicuous in the production of the effect, it is invariably set down as the sole agent in the business. Thus we say, that the Crown's assent to a Bill makes it law; or the casting vote of the Speaker was the cause of the resolution on the part of the Commons, in whose support it was given: and if we happen to be insisting on the requisiteness of such condition at the moment, one of a negative character is styled the cause of an effect with which it could have no positive relation; as, when we state, the cause of the army being surprised was the sentinel being off his post; or, the body fell because it was unsupported. We must, however, be aware, that as the absence of the sentinel neither created the enemy, or made the soldiers sleep, it could not

[1] Mill's Logic, vol. i. p. 400.

be the cause of their surprise; and, moreover, that the mere absence of a prop underlying a body could no more make it fall, than the absence of any obstruction to its motion above could make it ascend, or the removal of any lateral hindrance cause it to move horizontally. All such conditions being mere negations, are equivalent to non-existence, and from nothing, nothing can proceed. The real cause must obviously be placed in the fact of the stone being within the sphere of the earth's attraction, which impelled it to its surface with a force in direct proportion to its mass.

The cause of a phenomenon is, therefore, that condition, or aggregate of conditions, on which alone the effect depends. Its essential mark is in invariable and unconditional concomitance with its effect, so that from its simple presence the result follows without the interference of any other agency. Mere invariable sequence between two phenomena proves nothing, unless we can produce indubitable evidence of the fact that the one is the tangible result of the agency of the other. Day never ceases without introducing night, and night without being followed by day: yet everybody knows that day is caused by the sun illuminating our hemisphere, and that whether the night preceded or not, the appearance of that luminary in our sky would always be attended with the same effect. Though we cannot help inferring, having once witnessed certain agencies generate certain results, that wherever such causes operate unmolested by any counteracting agency the same effects must ensue, we cannot inversely take the presence of the effect as an irrefragable sign of the agency of the same causes. Thus, sugar can be produced from linen rags, under the agency of sulphuric acid, as well as from beet-root and West Indian cane. Honey would not at present furnish us with undeniable proof that the bee had been at work in hoarding its sweets, for that substance can be produced by subjecting starch to certain chemical processes. Death may be the effect of a variety of causes; nor can we infer from the mere presence of a shell on a rock, whether it dropped from the shallop of a pilgrim, the beak of a bird, or was swept there by the ever-shifting waves of the sea.

The ultimate basis of such investigations evidently proceeds upon the principle that every natural phenomenon must have a cause sufficient to account for its existence; and

it is as well to ask ourselves at the outset of the inquiry, what evidence have we of the truth of such a proposition, and whether there is any limit to its generality in nature? If such a principle spring from mere experience, it is evident we are unauthorised to apply it to any other class of effects than those whose causes we have discovered; and that a great many of the present researches of philosophers may be employed in looking out for causes that may not exist, and eventuate in demonstrations of the indemonstrable, and explanations of what cannot be explained. But such a belief no rational intellect can practically entertain. Its adoption would shut up the philosopher's laboratory as well as the courts of justice, since we could neither predict future results or infer from the present anything relative to the past. Among the ancients, indeed, to whom the material universe was a sealed book, some trace of such an opinion may be said to be discovered in their doctrine of chance; but that tenet by no means implied that objects could be produced without any sufficient cause, but simply that the causes which produced them, not being under the influence of any deity, were the result of capricious agency; a notion which modern science has completely destroyed by showing that the so-called theistic agencies are nothing else than laws so dependent on the internal constitutions of things, that when once the tie has been fairly established, we can in no instance, without the interposition of supernatural agency, imagine a separation. Accordingly, the introduction of the word chance in the ancient philosophy, instead of strengthening the empirical view of the question, only proves the utter repugnance of the mind to the belief that an effect can exist without a cause; since, when man in entire ignorance of natural laws referred every successive uniformity in nature to the direct action of a deity, rather than leave those phenomena which bore upon their front the marks of no forethought or design in their origin, without a cause, he at once assigned their production to agencies acting without rule or principle, and called their parent chance. But had he disenchanted space of his imaginary divinities, and transferred their functions to the agency of general laws, he would have wiped out of his vocabulary the word chance as a notion impossible to be entertained. He would have found it as repugnant to conceive a substance, acting according to other

principles than those which accorded with its own constitution, as to conceive the same substance existing without a cause; and have ascended with the moderns the ladder of scientific induction, applying the law of regular causal agency to every corner of the universe.

As relations, however, may be said to exist between co-existent as well as sequential phenomena, a distinction is sometimes attempted to be drawn between those properties which are merely derivative and the ultimate collocations of matter from which they spring. Though we can give a causal account of the manner in which the threads are interwoven which compose the fabric of the universe, and show how the figures are produced which dot its surface, by unravelling the skeins of which the web consists, it is argued that our power stops here; that we cannot pursue our investigation into the cause of the primordial fibres, into which we have decomposed the fabric, or produce any reasons for the proportions in which such ultimate qualities are found to co-exist. We can trace the influence, for instance, of the sun's attraction, and the tangential force imparted to each planet among the movements of the heavenly bodies, and derive all the phenomena which such motions involve from the effects of their combination, but it is said we can give no reason for the existence of the combination itself, nor trace any coincidence between it and the proportions in which the other elementary agencies of the universe are intermingled. In referring existing phenomena to their ultimate elements, through a series of complicated effects, we generally find, according to this view, that derivative laws do not depend solely upon the primary laws into which they are resolvable, but imply in addition a certain mode of co-existence among some of the original elements of the universe. Now this last-mentioned element, which is not a law of causation, but a collocation of causes, cannot be reduced to any law. Among such elements we are unable to explain why one substance exists in greater abundance than another, or why different powers act through various degrees and directions in space. The original elements of the universe may have existed in the greatest disorder, but if they act according to uniform laws they cannot fail to produce regularity of some kind; just as the capricious arrangement of coloured bits of glass in the kaleidoscope, through carrying the law of refraction

into their subsequent movements, produces a beautiful impression of order on the mind of the beholder[1].

This reasoning, however, is founded upon assumptions which are not in harmony with the actual progress of science, and in reality conflicts with the results to which the religious, deistic, and pantheistic cosmogonies would alike lead us. That the universe grew out of primordial elements, existing in a confused and disordered shape, discoveries of modern chemistry tends strongly to contradict, which show that the ultimate particles into which matter may be resolved, though bearing evidence of essential difference among themselves, may be arranged in a very limited number of groups or classes, all the individuals of which are exactly alike in all their properties, and when placed in similar circumstances exhibit no variety of deportment. Now, as the number of such atoms defies the multiplying powers of the calculus to compute, the inference is irresistible, that the uniformity they exhibit has been impressed upon them by an external agent, and that the evidence of variety which obtains among their indiscerptible molecules is just that very combination of properties by which such agent intended to produce that opposition and consistence of parts necessary to generate the great globe itself and the universe which it inhabits. From the ends produced in such case we can infer the precise collocation of original materials required to effect it; just as an architect can tell, on examining the design of an edifice, the combination of wood, masonry, glass, and other materials necessary to execute it. To call, therefore, such collocation a confused heap of causes obeying no regulating principle or law, is about as great a perversion of terms as imagination can conceive.

To say that final causes are not admissible in any account of this branch of scientific evidence is only correct in the sense which would place ultimate ones under the same ban of exclusion: of neither, inductive science, strictly speaking, can be said to know anything. Chemistry distinctly shows that the final results into which philosophical methods can analyse sensible phenomena are compound atoms, which admit of no further decomposition by any instruments that human agency can grasp; and with regard to the last word

[1] Mill's Logic, vol. ii. p. 45.

which mechanics have to say upon the origin of planetary motion, viz., a certain combination of centripetal and tangential force, Laplace has shown that both can be rationally accounted for, on the admission of the simple hypothesis that the sun, weakened by the enormous supplies of heat emitted from its surface, has gradually cooled down, abandoning successive rings of vapour consequent on the increased centrifugal force imparted to it by the diminution of its bulk. Science, consequently, knows neither force or substance bearing any semblance of an ultimate character; and to assume their existence in a certain manner, in any account of its methods, is a case of unwarrantable hypothesis, which may be said to be fairly disposed of if found to clash with legitimate generalisations in any other department of science.

But in reality the hypothesis in question necessitates the doctrine of final causes, and is found inconsistent with it. Among other conditions, it supposes a period when these original collocations of matter began to act according to regular laws, and in so doing involves itself in an inextricable dilemma. For if matter did not commence to act as soon as created, according to the uniform laws of the substances of which it was composed, it must have existed either from eternity or from some antecedent period of time in amorphous shapes, obeying no laws, or, in other words, exhibiting no marks of change among its properties. Now this latter supposition it is impossible to entertain, without weakening our notions of that steady uniformity of nature's laws on which all scientific methods are built. For what once happened might occur again. If it were possible for substances to exist without manifesting any action, uniform or otherwise, between their several properties, a suspension of all natural laws, without the interference of an internal agent, might take place to-morrow. We are consequently driven back by the hypothesis to the notion of creation, but find it completely at war with every notion of intelligent agency in the production of the universe In fact, there are only two kinds of cosmogonies possible: either the world must have been produced by a spiritual being, or the causes which we see at work must have no limit to their existence either in time or space. The absolute generality of the causal theory, as we have

enounced it, agrees with both. The hypothesis which would circumscribe it within a limited range of phenomena will not admit the one, and is completely sabred by the other[1].

§ 2.—*Observation and Experiment.*

From the foregoing view of the nature and objects of physical investigation, it follows that the first step in the inquiry is the ascertainment of the particular effects of which the universe consists, the several appearances, systematic or irregular, which their properties manifest, that we may be in a position, from a comparison of the results, to get some glimpse of their causes, by pursuing the analogies they suggest, and by subjecting the phenomena to such influences as the nature of the case shall point out as most likely to reveal their latent origin. As long as the notion prevailed that natural phenomena was the direct result of spiritual agency; that the whole of the present facts which the universe presents, instead of being the infallible product of all the facts which existed at the moment previous, were the immediate results of a divine intelligence, it could hardly be deemed unwise in the philosopher to shut himself up in his room and to attempt to reason out the prior states, or even the primordial elements of the existing frame of things, apart from the fluctuating phenomena he saw around him. But since the objects of nature have been shown to be connected in a compact web of mutual relations and dependencies, and to precede each other in a regular order of sequence,—each effect being generated by certain material conditions, which immediately preceded its occurrence, every individual of which in turn were generated by others,—it is obvious if we would analyse this complexity

[1] Though "metaphors are no arguments," as *Lady Hermione* says in the "Fortunes of Nigel," we may observe in passing, that the regularity springing from the capricious combination of coloured bits of glass in the kaleidoscope is the effect of one unique substance acting in accordance with its own laws, and that if any other substance were introduced into the arrangement, in similar disorder, the most chaotic confusion would ensue. The simile consequently fails in that precise point where illustration was wanting. That a confused collection of elements, without principle or method in the assortment of their parts, can ever generate harmonious phenomena, though acting according to the laws of their respective substances, we will believe when we see—but not till then.

with a view to attribute to every cause its effect, to every antecedent the consequent which it produced, we have no other course than to commence with examining the partial threads of which the web is composed, viewing them in every light that is calculated to afford any glimpse into their internal structure, and making a faithful record of the properties they exhibit in the various situations in which they have been tried, that reason may be guided by the resulting evidence, not only to lay its hands on the direct mechanism by which they have been produced, but to compute the amount of influence which they exercise over other elements, and the modification they receive by being acted upon by other substances in return. Throughout the whole of this process reason can only be considered in the light of a subordinate agent. She can only interpret the facts which nature puts in her possession: one single result of experience is sufficient to dissipate her brightest theories.

The mode of collecting instances must have distinct reference to the point we have in view, some requiring the registered observations of individuals situated in different hemispheres and centuries to establish anything in the nature of evidence co-extensive with the subject, whilst others are perfectly open to individual exploitation. If a single person wished to discover the actual direction in which changes of relative level are taking place between the existing continents and seas, it is evident that no exertion on his part could achieve his purpose, unless made in consort with observers scattered over every part of the globe. For the only way in which the point can be decided is, to select on the most prominent coasts, situated in different hemispheres, such marks as seem unlikely to change during the next century, and ascertain their true elevation above the mean level of the sea in the interval, by instruments adapted to the purpose. But such agencies, extending over generations and hemispheres, can only be set and maintained in action by different governments; or, at least, by mutual compact between scientific corporations.

The motives, however, which lead to the record of phenomena may be various; and provided the instance narrated be a *faithful* and *complete* account of objects before unobserved, their registry cannot fail to be of the highest moment to that branch of science to which they bear reference. Thus it

had long been known that the cell is the type of vegetable structure; that the simplest, as well as the most complex, plants are composed either of single cells or multiform aggregations of the same vesicle; but this truth was comparatively of minor importance until Schwann, led by the observation of the embryonic structure of certain tissues of animals, established the fact that the animal, like the vegetable tissue, originate in cells, and that all the laws of vegetable cellular formation apply, in every essential particular, to the simplest as well as the most complex organism of animal creation. Physiologists, previous to Schwann, had, while subjecting animal tissues to the microscope, perceived the appearances which indicate their origin in similar germ cells to plants, but passed them by as something mysterious, or too unimportant to be inquired into. Schwann, on the other hand, subjected them to minute examination, and by pursuing the analogy which the cellular structure of plants pointed out to him, opened the way to the most startling truths of the animal organism, and completely changed the aspect of physiological science[1]. Again, a soap manufacturer observes that the residuum of his ley, when exhausted of the alkali for which he employs it, produces a corrosion of his copper boiler, for which he cannot account. A scientific chemist, on analysing the matter, discovers one of the most singular and important chemical elements—iodine, which is found to occur most appositely in support of a variety of novel and instructive views then gaining ground in chemistry, and thus exercised a marked influence over the whole body of that science. The new substance is subsequently discovered to be a prompt cure for the goître, being traced through sea plants and other marine substances from whose ashes the principal ingredients of soap is extracted to sponge, which had administered some relief to the victims of that disorder. Intelligent workmen, therefore, at this stage of the inquiry, are capable of being of immense service to philosophy, and might write their names in its annals if they chose to record every singular instance that crossed their path, and noted all the particular circumstances attendant upon it. The habit of minutely observing and particularising the results of such phenomena could hardly fail to

[1] Mikroscopische Untersuchungen über die Ubereinstimmung in der structur und dem Wachsthum der Thiere & Pflanzen. Berlin, 1839.

suggest to intelligent minds analogies similar to those just narrated, which might prove the germ of equally brilliant discoveries. Physical science has advanced rapidly since Bacon pointed out the great importance of this branch of the subject, leaving a noble pattern both of the industry and zeal[1] with which it should be prosecuted. But had each one felt in the interim the extent to which he was capable of assuming fellowship with so great a mind, it is hardly too much to say that science would have been looking back on the positions she has reached to-day as mere starting-posts in her dazzling career.

In geology, meteorology, and other sciences, which can hardly be said to be out of the descriptive stage, and whose objects are co-extensive with the globe we inhabit, the observations of great numbers of individuals, widely dispersed, are of manifest importance, as constituting the only means by which these sciences can be carried through their infancy, and connected by a series of intermediate generalisations with laws sufficiently ultimate to allow the deductive element to become an agent in their progress. But to ensure the widest advantage to the labours which all well-informed persons might carry on, and to stimulate them in the pursuit, it ought to be an object with every scientific body to point out in what direction certain groups of instances tend; what kind of facts are required either to turn the rising generalisation into a law, or to test its accuracy; what class of persons are most favourably situated, either by their calling or position, for meeting with them; and what attendant circumstances are most likely to prove influential in modifying the phenomena. By such division of labour the inquiries of large masses of individuals would be stripped of vague generality and concentrated upon critical objects; and the separate results of their experience transmitted to a common centre, might enable judges skilled in interpretation at once to pounce upon the law.

In recording or observing facts, whether to answer any

[1] His *Sylva Sylvarum*, in the attempt to extend which he sacrificed his life. When dying he said the experiment which caused his death "had succeeded excellently well." The elder Pliny, whose collection of registries would have broken the back of an elephant, perished in exploring the crater of Vesuvius. His note-books, four hundred in number, have not come down to us. Aristotle afforded another great instance of this kind of industry in his work on animals, but only fragments of his labours have reached posterity.

definite question, or simply to register some peculiar phenomenon which has presented itself to us, we must be careful to omit no circumstance in the account, as the neglected condition, like one of the quantities in an algebraic statement, might be essentially connected with the solution, and so mar the revelation of the cause. For instance, the fall of meteoric stones, being accompanied with flashes of fire, issuing from a cloud, and a loud rattling noise like thunder, was long confounded with that of thunderbolts; but had it been observed that the flash and sound occasionally emanated from a very small cloud insulated in a clear sky, instead of attributing them to electric agency, philosophers would have sought for their cause in the very circumstance which separated them from that phenomenon. In order to guard against such omissions it is necessary to have each of our senses brought in actual contact with the phenomenon, and let nothing escape notice which affects any one of them. Thus, if lightning were to strike a house we inhabit, we ought to notice the form, colour, and duration of the light we saw, and to what objects it adhered; whether any smell of fire was perceptible, and if sulphurous, metallic, or such as would arise from substances scorched with flash; what sounds were heard, and whether we felt any shock, stroke, or peculiar sensation, or experienced any strange taste in our mouths. The modifying circumstances should then be noted, such as the presence of conductors, the neighbouring objects, the state of the atmosphere, and the disposition of the clouds. After all this particularity the question how the house came to be struck, would have to be determined: whether by what is termed a returning stroke, or by a flash of lightning passing from the clouds to the earth.

Our record of observation should not only be circumstantial but faithful, or, in other words, consist of what we have observed, and nothing else. Without any intention of perverting the description, we may distort simple facts by clothing them in the views and language of an erroneous theory. Thus, if we said—the thunderbolt struck with violence the side of the house and beat in the wall, our hearers would be led to believe, by the statement of a fact which we did not see, that a solid, or ponderable projectile was concerned. The smell of sulphur which is sometimes said to accompany the electric fluid, is a remnant of the theory which

made thunder and lightning the explosion of aërial gunpowder, composed of nitrous exhalations. The elder chemists were so addicted to the mischief of representing facts in the language of idle theories, as to falsify the descriptions of innumerable important and curious experiments. In geology, particularly, the Vulcanists and Neptunists so far set the purposes of language at defiance through this practice, that it was totally impossible in their descriptions to get at the facts observed. In like manner, Faujas de St. Fond, in his work on the volcanoes of Central France, describes, with that particularity which belongs to fact, craters existing nowhere but in his own imagination[1].

It is of immense importance, with a view to guard against such errors, and to secure our observations from the illusions frequently practised on us by the senses, to verify or accompany them with accurate numerical statements, according to such measure of time, space, or quantity as they appear to admit of. It was entirely to the omission of exact numerical determinations of quantity that the blunders of the Stahlian chemistry and the Ptolemaic system of astronomy are attributable; and the correct expansion of these, as well as the rest of the physical sciences, may be said to have been in proportion to the extent to which their objects have been open to the legitimate application of this element. All phenomena more or less admit of accurate measurement, to such a degree that the very class which are so fluctuating and irregular in their occurrence as to appear an exception, cannot be pressed into the service of science by any other means. The thousand capricious agencies by which the atmosphere is hourly influenced, and the irregular action of winds, tides, and currents, must ever prevent us from ascertaining either the general temperature, or the mean level of the sea at any particular locality, by the unassisted senses. If we would reduce such irregular

[1] Herschel's Discourse on the Study of Natural Philosophy, p. 130. A vague and loose mode of looking at facts very easily observable, left men for a long time under the belief that a body ten times as heavy as another falls ten times as fast; that objects immersed in water are always magnified, without regard to the form of the surface; that the magnet exerts an irresistible force; that crystal is always found associated with ice, and the like. These and many other examples show how blind and careless man can be, even in registering the plainest and commonest appearances; and prove that the mere faculties of perception, although constantly exercised upon innumerable objects, may long fail in leading to any exact knowledge.

agents to any kind of law, or hinder them from defeating our discovery of the laws of the elements with which they come in contact, we must call in the assistance of instruments adapted to measure the precise scale of their variation within a given period and locality, and combine the mean amount with the result[1].

Observation, even where supported by exact measurement, in many cases, will go very little way towards establishing the cause of a phenomenon, unless we are able to vary the concomitant circumstances, and view the cause, generate the effect, or vary in exact proportion along with it. Though there was every reason to attribute lightning to electric agency, the fact was never considered definitely made out until Franklin threw up his kite in the air at the approach of a thunder-storm, and obtained the same sparks from his cord as invariably accompanied its connexion with an electric machine. As nature is constructed for a widely different object than that of facilitating our studies, it frequently happens, indeed, that she refuses to afford the precise kind of variation needed to establish the law we are in search of, and leaves us to rack our invention to institute a case in point by direct experiment. Thus, were it required to ascertain the principle in the atmosphere which enables it to sustain life, we should find no instance in which nature produces either oxygen or azote in a separate state, to enable us, by immersing a living animal alternately in both gases, to decide the question. We are exclusively indebted to experiment for the fact, that respiration is supported by oxygen, and also for our knowledge of the ingredients of which the atmosphere is composed.

Hence experiment, besides multiplying the advantages derived from passive observation, accomplishes that which passive observation is seldom adequate to perform. It enables us to march directly to our object and to link it indubitably with its cause. By experiment we are enabled to study the laws of nature in our laboratory, and subject the wildest elements to our control; to multiply our knowledge of their several properties by introducing such agents among them as seem calculated to reveal their laws. By experiment we are enabled to bring theories to the touchstone of fact, and prevent hypothetical fictions from spreading darkness over

[1] This process concerns the doctrine of chance, which will be treated of under the section of empirical laws.

centuries, and making genius actually instrumental in pushing back science instead of becoming an impulsive lever in its advancement. To this element is to be ascribed the creation of physical science in the fifteenth century, and much of its wonderful progress during the intervening years. To its absence among the ancients must be mainly attributed their entire ignorance of physical laws, and their subjection of nature to imaginary divinities.

It is, however, of importance to observe that the use of this great instrument is suggested in a large degree by the results the mind has gathered from pure observation, which generally takes the initial step in the physical sciences. Before mounting to the cause of any phenomena, we patiently observe its effects and examine its laws. Here pure observation alone is applicable. But the results to which it arrives suggest in what agencies it may originate, and experiment is ever ready to bring such hints to the test, and where nature does not present a case in point to create an instance that will decide the question. Hence experiment is mainly applicable in inquiring into the effect of a given cause. So far as we are strictly concerned with investigating the causes of a given effect the process is one of pure observation[1].

§ 3.—*The Methods of Experimental Inquiry. Discovery of Minor Laws; their Extension and Verification.*

Having collected a certain number of instances bearing upon the chosen point of inquiry, it remains to determine the nature of the evidence which will entitle us to conclude that a certain course is followed by a given effect, or under what circumstances invariable sequence may be allowed to establish a causal connexion between the phenomena. The marks commonly adduced in evidence of such relation may be generalised under four heads[2], though in practice, the actual signs by which causes reveal themselves are frequently only corollaries from them, or are traceable not to one distinct cause alone, but to two or three in conjunction. It will then be sufficient, for an accurate knowledge of the

[1] The reader is referred for classification and nomenclature to the Supplement of this Book in the Appendix. [2] Bacon's Novum Organum, commencement of 2nd book; Herschel's Dis. Stud. Nat. Phil. p. 151; Mill's System of Logic, vol. i. p. 450.

subject, to give the leading causes of induction in full, pointing out their specific ground, differences, and merits, and leave their mode of application to be gathered from the instances we shall adduce in illustration of their properties.

The first mark, by which we are generally led to infer the presence of the relation we intend by cause and effect, is uniform connexion, provided the circumstances in which the concomitance has been observed are sufficiently various to exclude doubt that it could have originated from any relation but the one assigned. For instance, let the object in view be to ascertain the cause of death produced by metallic poisons. It is observed that arsenious acid, and the salts of lead, bismuth, copper, and mercury, if administered, except in the smallest doses, destroy life. Now this effect obviously can only follow from the violation of some of the conditions on which animal organism depends, so that the question arises which of those conditions seems most likely to be interfered with by the substances in question, and how can metallic poisons be brought in contact with it. The most obvious mode is to trace the effects of these substances on the composite ingredients of the animal system, and observe what law or vital function of organism they arrest or enfeeble. If the effect obtain in the separate parts at different periods of their formation in an isolated as well as in a combined state; and if the remotest quantities of such poisons tend to disturb the same law of the animal economy, there could remain no doubt that interference with its functions was the effect of introducing them into the animal system and the proximate cause of death in every case in which they were administered. But the effect of placing solutions of metallic poisons in contact with albumen, milk, muscular fibre, membranes, and other animal products, is that the acid or salt having left the water in which it was dissolved unites with the animal substance, and destroys its tendency to decomposition. The same effect is perceived in cases where death has been produced by these poisons, the parts of the body with which the poisonous substances have been brought into contact not afterwards undergoing the law of putrefaction: and when the poisons have been supplied in too small a quantity to destroy life eschars are produced, through the destruction of superficial portions of the tissues, which are subsequently thrown off by the reparative process taking

place in the healthy parts. Hence the conclusion is patent that these metallic compounds, when taken into the system, cause death, by arresting the law of decomposition. In the instances adduced all point to the arrest of the same law, and this could not have occurred with antecedents varying according to every conceivable mode of which the case admits, unless they had generated the consequent apart from every other agent.

In this illustration we have proceeded, according to the general route of scientific inquiry, from the effect to the cause. But it may happen that the effect of a cause is required to be known, in which case we must find or produce the cause in such a variety of circumstances that it may be fairly presumed that the different instances could have no other antecedent in common. Then it is obvious that if any unvariable result appear in each combination of consequents, that must be attributed to the cause which is the only invariable element in every new set of antecedents. Thus reversing the example already adduced, as the effect of metallic poisons in every instance, in which it can be brought into connexion with organic compounds is to arrest the process of decomposition, we experience no hesitation in attributing that result to their agency.

But it must be observed that this method, which proceeds by comparing instances to observe in what they agree, is not of very wide application, as it is liable to be defeated by two obstacles at every stage of the inquiry. Either nature may not present, or experiment fail to obtain, instances in sufficient abundance to ensure the variety necessary to lead to a legitimate induction; or the number of instances being secured, counteracting causes may interfere to modify or neutralise the agents at work, and so prevent the instance from throwing any clear light on the inquiry. In a great number of natural phenomena the effect is produced gradually, and frequently diminishes in strength, while the cause often goes on increasing in intensity, so that the antecedents of the one and the consequents of the other become difficult to trace. On the other hand, the effect often follows the cause so instantaneously that the interval cannot be perceived, and we are left without any marks to discriminate the cause from the effect. Owing to the frequent occurrence of these cases, the method of agreement in the generality of inquiries is incapable by itself of leading to a certain result.

The second mark of causal relation between two phenomena is invariable negation of the effect with absence of the cause, and *vice versâ*, unless some other cause be capable of producing the same effect. This may be styled the method of difference. In the former method we endeavoured to obtain instances which agreed in the presence of the object whose cause or effect was sought. In the present method we require, on the contrary, instances resembling each other in every respect but the presence or absence of the phenomenon we desire to study. Thus, if our object be to discover if air be an essential condition of sound, we need only place a watch under a glass receiver, and observe its ticks fade on the ear as the air is withdrawn from the interior, until by the completion of the exhaustive process they cease altogether. Here we have an instance of the presence of motion in the sounding body combined with the contiguity of the ear to catch the beats, but unaccompanied with sonorous vibration; or, in other words, the absence of one of the essential conditions—the cause, with the negation of the effect. On re-admitting the air, the beats are again found to strike the ear, thus proving by the strongest evidence the dependence of sound on that medium, and suggesting in some measure the nature of its functions. Again, in the case of introducing metallic poisons into the animal organism, if we can show that death is prevented by administering an antidote which shall hinder the acid from arresting decomposition by combining with the animal tissues, we should exclude the effect by taking away the cause, or, in other words, prove, by the method of difference, that metallic poisons destroy life through the agency in question. Now, such antidotes are afforded by the application of sugar, sulphuric acid, or hydrated peroxide of iron; for each of these substances as soon as administered prevent, by different agencies, the salts of copper from entering into combination with the animal tissues, and in this wise preserve the law of decomposition intact[1]. Occasionally this

[1] It may be observed in the two examples adduced that the instances in the first case only differ by the absence or presence of the same circumstance, viz.: air under a glass receiver; while the difference of the last consists in the introduction or exclusion of a single substance. But as every substance may have innumerable properties, the supposition is just conceivable that these antidotes may counteract the poison through some other mode than that of forming an insoluble

mark of causation, besides leading to the establishment of a general fact, points to contrary, or opposing facts, as equally established by the same evidence. Thus, if rust be produced by confining iron filings in a closed vessel over water, the enclosed atmosphere will be found to quench the flame, or destroy the life of any animal immersed in it. Now this experiment not only shows that the remaining gas of which the enclosed atmosphere is constituted will not support life, but that the ingredient of the atmosphere which supports flame and animal life must be attributed to that which the iron absorbs and which rusts it. It is to similar inferences we owe almost all the inductions of daily life. When a man is shot through the heart, we learn by this process that it was the gun-shot which killed him; for he was in the fulness of life immediately before, all circumstances being the same except the wound.

Hence the method of difference stands on the ground that whatever cannot be eliminated without the subtraction of the phenomenon is connected with the phenomenon by law; while that of agreement has for its foundation, that whatever can be eliminated without removing the phenomenon is not connected with the phenomenon by law. Of the two methods, that of difference is more particularly open to experiment; while the other is commonly the resource we employ where artificial experiment is impossible. In examining the nature of any effect with a view to ascertain its origin, we compare its points of agreement in as many variable circumstances as possible. The method of difference tries the causes which such cases suggest by comparing two instances exactly similar in every circumstance except the cause in question. If, with the same set of circumstances in which the presence of the cause is succeeded by that of the effect, the absence of the cause is followed by its negation, what was simply a suggestion before becomes an established certainty. We need hardly say, however, that nature is not so propitious to our studies as to lavish such instances upon us. If we want them, in eight cases out of ten we must devise instruments by which they may be pro-

compound with it, in which case the evidence would fall to pieces. Hence, as the first class of cases do not admit of this barely conceivable uncertainty, the conclusions established by them belong to the highest rank of physical certainties.

duced. The majority of the great truths established by the method of difference,—and they are the most important that science reveals to us,—have been extorted from nature by artificial experiment. On the other hand, in comparing instances of agreement, we must rely on pure observation for the result; unless, indeed, we can produce the cause whose effect is sought in sets of circumstances, sufficiently various to exclude doubt that the result common to every instance originates from any other source than itself; a belief which, as it grows with every instance, is never of that convincing nature with that produced by the method of difference, which enables us, by one well-chosen experiment, to lay our hand upon the cause, and say indisputably it is there. In the former method, as the circumstances are different in every case, we can never be infallibly secure that the constantly-recurring effect may not arise from some latent cause or particular combination of the various properties which substances are apt to manifest in different situations, instead of being generated by the constant antecedent whose effect that combination may neutralise in each instance. Now the method of difference, in its most rigorous sense, excludes even that shadow of possible doubt. For the two instances compared only differ in one circumstance—the absence or presence of the phenomenon we wish to explore; so that we actually see the effect generated under our eyes.

The two methods, however, are not unfrequently combined in scientific investigations, though the juncture arises from a lax application of the method of difference in cases where the rigorous employment of it is impossible. Sometimes the phenomenon we wish to investigate is associated with a number of properties combined in the same substance, which we are incompetent to separate so as to render the production of a substance impossible which shall exactly resemble the one in question, except in the particular property we desire to study. Suppose, for example, the polarisation of light is the subject of inquiry. The complicated phenomena which are designated by that name are impressed upon light in the act of double refraction, or by ordinary reflection at the surface of a transparent body. But we cannot produce any substance which shall resemble either transparent bodies or doubly refracting crystals, except in the one property of polarisation. Our only mode is to examine in what kindred

qualities polarisation, ordinary reflection, and double refraction, individually agree and differ, and endeavour from the resulting analogies to get at the causal relation. This mode of inquiry combines the method of agreement with that of difference taken in an indirect sense. The instances which fall under the latter branch, instead of agreeing in all but the presence or absence of the phenomenon in question, may differ in many other qualities besides; so that although, when conjoined with the method of agreement, all doubt may be eliminated where the individual inductions have been sufficiently extensive, yet the possibility is never completely banished that the remaining differences may not have had some share in producing the established connexion. Thus we compare instances of bodies which undergo putrefaction with those which do not manifest that tendency, and discover that water is always present in the one case, and absent in the other; and find, moreover, that salt, which is an admirable preventative of this tendency in animal substances, has a strong attraction for this element. Though the evidence amounts to scientific certainty that the ingredients of water, combining with some properties of the substance[1], produce decomposition, we are not driven to the conclusion with the same force as if the evidence had rested upon two instances differing in nothing but the conjoined absence and presence of the element in question. For, in the former case, the possibility remains that putrefaction, or non-putrefaction, in the instances compared, may arise from the presence or absence of other properties besides water. This method, however, which unites all the advantages of the method of agreement with a modified portion of the method of difference, is undoubtedly one of the most universal instruments which science employs. Its use is simple and obvious, and the conclusions to which it leads are less exposed to cavil than those which entirely depend on the strict method of agreement.

The precise sphere of the application of this method is coextensive with that large class of phenomena which, on account

[1] It has been shown by Liebig that the properties in question are carbon and azote, the hydrogen of the water combining with the former and producing carbonic acid, while the oxygen unites with the azote and generates ammonia. Now carbonic acid and ammonia constitutes the gaseous compound which animal and other azotised bodies throw off in a state of decomposition.

of the complexity of their nature, will not admit of the direct method of difference; and whose properties do not appear in circumstances sufficiently diverse to allow any cogent conclusion to be drawn by the method of agreement. For instance, if we wish to investigate the proximate cause of animal heat, the phenomenon being constantly associated with the living organism, can neither be detached from a crowd of other properties, nor viewed in connexion with any variable combination of them. Now, even if we should observe in a thousand cases that all animals, whose respiratory system is well developed and aërates the blood perfectly, are warm-blooded, we should never be justified in attributing, with more than probable certainty, the phenomenon in question to the change which takes place in the blood by respiration; but when we observe that those whose respiratory system is imperfect do not maintain a temperature much above the surrounding atmosphere, that inference assumes the character of scientific certainty.

This method answers to what Bacon called negative and positive instances, and has been happily termed by Mr. Mill the indirect method of difference[1].

The fourth mark of causation is that of residual phenomena, which remain in many cases after subducting the effects of all the known causes, and which point to an agency that, from the nature of the circumstances, could only generate their production. For instance, in the return of comets, there is perceived that general agreement between their observed and calculated places as to lead to the inference that the sole cause of their orbitual motion is the gravitation of the sun and planets; but when the effect of this cause is strictly calculated and subducted from the observed motion, we find some diminution of its periodic time, which cannot be accounted for by any other supposition than the resistance of a medium disseminated through the celestial regions. Now, as there is good ground from other quarters for believing that such a medium actually exists, this anticipation of a comet's periodic time has been ascribed to such a resistance[2]. We cannot, however, be certain that such residual phenomenon is actually produced by the cause it suggests, unless we are perfectly assured of the

[1] System of Logic, vol. i. p. 462. [2] Professor Encke. See Herschel's Astronomy.

existence of such cause, and can also prove that no other agent could have produced the residual effect. Now, as this rarely happens, the strict application of the method of residues is limited to very few cases. It may, however, serve to suggest causes which we may try to produce artificially, according to one of the two first methods, or which can be explained and proved deductively from known laws. The last case is one of frequent occurrence, and constitutes one of the principles by which science in our day has been so much extended. Thus, in calculating the velocity of sound, although the general result was sufficient to show the correctness of the cause and mode of its propagation through the air, yet the velocity was a little above what could be legitimately ascribed to this theory. Laplace at length surmising that the residual velocity might arise from the heat developed in the act of condensation which ensues at every vibration of the air, subjected the idea to exact calculation, and the result was at once the complete explanation of the residual phenomenon, and an unexpected confirmation of the general law of the development of heat by compression.

The fifth mark of causal connexion is increase or diminution of the effect with corresponding variation in the cause, an example of which may be observed in the method by which Pascal satisfied himself of the gravity of air. That philosopher knew that if the weight of the incumbent air be the direct cause of the elevation of the barometer, that the column of mercury would sink in proportion as he ascended the Puy de Dome[1], as the pressure of the air would diminish with every step he took. The result of the experiment verified his conviction of Torricelli's views, and settled the dispute to which they had given rise for ever. This method of investigation, which is called that of concomitant variations, though constantly employed in conjunction with the other methods, is mostly of use in ascertaining the law of permanent causes, which it is impossible either to exclude or to isolate; which we can neither hinder from being present, or contrive that they shall be present alone. To these cases the other methods are confessedly inapplicable. Suppose, for instance, it arise as a suggestion that the oscillations of the pendulum are produced by the earth's gravitation, we can in no case exclude the earth as an influencing agent, nor can we argue

[1] A high mountain in Auvergne.

from its constant presence, that it causes the phenomenon in question; for by parity of reasoning we might affirm the same of the sun, which is equally co-existent in all the experiments. Now, though we cannot remove the earth, we may modify its influence, and that to a sufficient extent to enable us to decide upon the point in question. For if, as Bacon suggested, the pendulum tends downward in its oscillations by the influence of the earth's attraction, "it will follow, the nearer it approach to the earth the stronger, and with the greater force and velocity will the pendulum be drawn to it; but the further the pendulum be removed, the weaker and slower will be its oscillations[1];"—a suggestion which Professors Airy and Whewell fully realised by comparing the motions of a pendulum in Dolcoath Mine with a chronometer balance, and striking the difference between the velocity of the same motions as previously ascertained at certain elevations above the earth's surface. By the same method Bacon also pointed out[2] that the tides might be proved to originate in the influence the moon exerts on the earth's surface, if it could be established that the variations in the position of that satellite are attended by corresponding variations in the time and place of high water. The great Newton subjected the phenomena to the laws of the calculus, and proving the concomitant variation to the nicest degree of exactness, revealed the laws of one of the most admirable contrivances in the economy of nature.

Hence it may be inferred, when objects vary according to some fixed quantity which is the ordinary rule, that it is indispensable to the establishment of causal connexion by this method, that the phenomena should be submitted to quantitative laws, and their mutual influence proved to increase or diminish in the same proportion with the action of their causes. Now in such cases we cannot determine the exact proportion in which the relations vary, unless we know the total quantities of which they consist. Thus in the case of contraction of substance, since we neither know how much heat there is in any body, nor what is the real distance between any of its particles on which its bulk depends, we are not in a condition to infer that the con-

[1] Novum Organ. vol. ii. *Instantiæ Prerogativæ.* [2] Novum Org. vol. ii. Ibid.

traction of the distance between them would follow the diminution of the quantity of heat, according to the numerical relation that the two quantities would vanish simultaneously. It would, therefore, be hazardous to conclude that because the diminution of temperature in a body contracts the space between its particles, that we could bring its particles into contact, provided the process of exhaustion was urged to its full extent. In conjunction with the uncertainty that beyond the limits and in circumstances of which we have no direct experience some contracting cause may manifest itself, we have the doubt that the law of variation which the quantities exhibit within the observed limits will hold beyond those limits. There are many laws of variation in phenomena whose differences are inappreciable when confined within narrow limits; but which manifest a wide discrepancy when the absolute amounts of variation are considerable. In such cases, therefore, when the variations which fall within the sphere of observation are of limited range, there is considerable danger, if the numerical laws which express those variations be stretched to a considerable extent beyond the limits originally calculated, that they will fail to support the theoretical structures built upon them[1].

The employment of this method may be occasionally attended with doubt as to which of the phenomena is the operating cause. The only way to clear up the matter is by endeavouring to ascertain whether one set of variations can be produced by means of the other. In the case of heat, for example, by increasing the temperature of a body we increase its bulk; but by increasing its bulk we diminish its temperature. The conclusion is obvious, that heat is not an effect but a cause of increase of bulk. If experiment, however, be not available in the case, we must look out for instances produced by nature in cases where the pre-existing circumstances are already known.

[1] A striking example of such miscalculation may be observed in the formulæ by which it was computed, from the amount of coal that a steamer of average horse-power would consume in a transatlantic voyage, that no vessel could be found to carry fuel sufficient to supply the engines which she carried throughout the journey;—a computation which led many to infer, before the experiment was tried, that the undertaking was impracticable.

It will be observed not only that most of these methods may apply to the same act of induction, and so operate to test or verify the correctness of each other's processes; but that they are all, with the single exception of the method of difference taken in its most rigorous sense, exposed to the same uncertainty; viz., that the presumed effects may be brought about by the action of other causes than the uniform antecedents to which we attribute them; or, at best, if they should really act as influencing agents, that their ubiquity with the effects does not make out direct causation, but only a collateral effect of it. Such uncertainties, however, where the conditions of each method have been satisfied in a sufficiently large circle of instances, and especially where the methods tend to verify each other's results, dwindle down to an almost inappreciable value. They become, therefore, objects of metaphysical, rather than of logical concernment. In circumstances, however, which do not admit of rigorous precision in the application of each method, a strong probability of causal connexion can only be considered to have been established, or at most the collateral dependence of the phenomena in question, on some common cause. Unless, for instance, in the case of concomitant variations, we can really ascertain that the phenomena do vary in exact proportion to their mutual operations, the result is only one of strong probability; nor, indeed, can it be relied upon even when made out by quantitative laws, if those laws only express the results of observation restricted to narrow limits.

Where the induction, however, has been established by the fulfilment of all the conditions that scientific certainty requires, we are not to throw our conclusions lightly aside when a single fact starts up which seems to convict them of error, but rather to set the outstanding exception apart for future examination, being convinced that further inquiry will either destroy its hostility to past results, or verify or extend the facts which they have established. Thus the objection was brought against the Newtonian theory of gravitation, that it did not account for the perplexing inequalities of the moon's motions, and several minor irregularities in the planetary system, which seemed violent outstanding exceptions to it. Further inquiry, however, transformed these seeming discrepancies into the strongest

confirmations which that theory could receive, and extended its influence from those globular masses which Newton had previously included under it to every particle of matter in the frame of the universe. An additional instance may be cited in the law of isomorphism, discovered by Mitscherlich, which announced that certain distinct groups of chemical elements of which all bodies consist are so related that when similar combinations are formed of individuals belonging to two, three, or more of them, such combinations will crystallise in the same geometrical forms. To this law there appeared a remarkable exception in arsenic and phosphoric acid, which, though seeming to constitute identical combinations with those included under Mitscherlich's law, yet refused to crystallise in similar forms. But on further investigation, the compositions of the two salts were found to deviate essentially from that similarity required by the law of isomorphism, and a new phosphate of soda was produced, differing from that generally known under the name of phosphoric acid, in containing a different portion of water and agreeing in composition exactly with the arseniate, the crystals of which, when examined, agreed precisely in form with the arseniate. The removal of the objection consequently led to a further verification of the law. Again, in the same science, it has been observed[1] that, though ammonia is a strong contradiction of the law which attributes the alkaline quality of the alkaline and earthy bases to the presence of oxygen combined with one or other of a peculiar class of metals, that there are almost certain indications that this exception is not a real one, but assumes that appearance in consequence of some modifying cause not understood. Such objections generally appear in the form of residual phenomenon, which, when minutely examined, are invariably found either to extend and corroborate the induction against which they were brought, or give rise to an unexpected and novel class of laws.

(1st.) As the processes by which nature conducts her operations are frequently of an analogous character, one of the most ready means of extending single inductions is by discovering cases in which, from the general constitution of things, similar laws are able to act, and endeavouring to

[1] Herschel, Stud. Nat. Phil. p. 154.

establish results precisely analogous to those already adopted. Thus, Schwann having observed that certain animal tissues originated in cells, was led by the analogy of plants to the discovery that all the organs of the animal structure, together with the original fœtus, took their rise in similar cells, and reached their highest development by aggregations of the same or slightly different vesicles. In like manner Young was led to infer, from the fact that two vibrations of sounds arriving at the same place by different routes, either strengthened or wholly or partially destroyed each other's effects, that, if the undulatory theory was true, two rays of light might be made to combine so as to produce darkness; a fact which had no sooner been established than it led to the explanation of optical phenomena of a most remote kind.

(2nd.) Another mode of extension is that of examining all the cases which present the necessary conditions for bringing the newly-revealed law into action; a process, indeed, which commonly leads to the discovery of special laws before unsuspected, and explanations of others only empirically known. Thus Faraday having established the fact that electricity is evolved by all magnets, great or small, even including the earth, provided a conductor move at right angles to the direction of its poles, began to look out for fresh instances in which these conditions meet. Now, in the northern regions, where the earth's magnetic poles are nearly perpendicular to the horizon, all horizontal wheels made of metal, running streams, and other conductors, moving at right angles to the polar direction, must comply with the conditions of the law and charge the air with electricity. In these latitudes, therefore, a larger display of the phenomena produced by this element must be expected, and we find it in the Aurora Borealis[1].

Another example of the latter kind of extension is to be found in the mode by which Professor Graham was led, from the general law that gases have a strong tendency to permeate animal membranes and diffuse themselves through the spaces which they enclose, to establish a number of special laws explanatory of various phenomena in connexion with

[1] Faraday does not attribute the entire effect of this startling phenomenon to his law, as it would be unscientific to do so. He is, however, fully justified in the inference that it has a great share in the operation.

the animal system. Thus malaria is accounted for by the tendency in the animal body to absorb those gases rapidly, which are not already contained in the system; as, for instance, carbonic acid and ammonia, the gases which putrifying bodies exhale. By the same law, the heat and intoxication consequent on the consumption of spirituous liquors may be attributed to the rapid spread of vapour throughout the system, as the alcohol is driven above the boiling point by the temperature of the stomach. These, with many other explanations of phenomena to which the same law leads, are only so many special cases of its action, and started into being as soon as its acute discoverer began to inquire in what cases the law might be expected to operate.

Now there is no place in which a new element is so likely to have influence as in those sciences whose subject-matter is of a kindred character, or which manifest phenomena of an analogous tendency. Hence it becomes important when a new induction has been established, that the property or law to which it refers should be studied as many ways as possible in connexion with laws which exhibit similar relations. By this method of extension many classes of facts viewed as the nucleus of so many distinct sciences have been merged into each other, and afterwards included in one or two general laws. Thus the class of properties contemplated by magnetism has been resolved into two opposite currents of electricity; and there can hardly be a doubt that the property of polarity may yet be similarly derived from those of attraction and repulsion, and both in some measure shown to have a direct connexion with gravitation. There is nothing so instructive as this pursuit of the consequences of a new law into cases where its operation is likely to be traced; and illustrations of its successful action may be encountered at every stage of scientific history. Thus, Kepler having ascertained the orbit of Mars to be an ellipse in which the sun was one of the foci, and that the square of the periodical times was proportional to the cube of the distance, sought the same laws in the motion of the other planets, and found that each, together with the motions of their satellites, were only so many additional instances of their operation. By a similar extension of induction to analogous cases, Galileo broke down the barrier which Aristotle had erected between the laws of terrestrial and heavenly

mechanics, and showed the motions they mutually exhibit were resolvable into the same dynamical forces. Newton had no sooner enounced the principle of gravitation than illustrations of its action were found in every corner of the universe, and every minute particle of matter included in the operation of the same law. In like manner selenium was hardly discovered by Berzelius in the vitriol works of Fahlun, when it presently made its appearance in the sublimates of Stromboli, and the rare and curious products of the Hungarian mines. And thus it is with every new law and general fact. It is hardly enounced before its traces are found everywhere, and every one is astonished at its having remained so long concealed.

(3rd.) Since each natural phenomenon is united, through a series of mutually dependent agencies, with every branch of science, there is no induction which, by the outlay of a little sagacity, is not capable of leading to the most important results in whatever direction it may be applied. The laws of light no sooner led to the formation of a correct theory of vision than Kepler explained the functions in that act, of each part of the eye; and thus prepared the way for the invention of the telescope and microscope, by which the kingdoms of nature were ransacked at both ends, and man endued, as it were, with a new sense to enable him to explore her most minute as well as her grandest operations. If we would, then, extend the boundaries of knowledge, each induction must not only be looked at with a view to obtain exemplifying cases, but also as a certain species of vantage ground from which the unknown in other sciences may be attacked with the greatest prospect of success. The precise relation of each induction to the phenomena which surround its confines, both in its own science and others to which it manifests a direct relation, should be considered, with a view to obtain further insight into their character, as well as instances which extend and illustrate its action. It was owing to the intimate nature which exists between crystalography and optics that the laws of light led to the discovery of the most important qualities of crystalline substances; and those bodies in turn extended our knowledge of the laws of light, and even in some degree decided the merits of the rival theories concerning its transmission. So true is the remark of Bacon, that no natural phenomenon can be adequately studied in

itself alone, but to be understood must be viewed in connexion with all nature.

(1st.) Every additional instance of the application of the induction to new cases not originally included in the law will, of course, help as so many distinct illustrations of its truth to verify the correctness of the process by which it was reached; nevertheless, when the cause or law which it has laid bare assumes the form of an additional instance of a more general cause already well known and recognised, the verification cannot be considered complete until we trace the action of the original cause as modified by the circumstances of the particular case, and prove that the induction is corroborated by the result. Thus the law that salt preserves animal substances from putrefaction by its attraction for water, could not be considered as completely established till Liebig showed the phenomenon was a direct consequent of the necessity of the presence of water to generate the gases thrown off by bodies in a state of decomposition. And in like manner the induction which led the same illustrious chemist to the relative functions performed by the serum and globules of the blood in the act of respiration, was not fully verified until traced deductively from the chemical properties of oxide of iron, the substance which the globules secrete, and proved to be the precise consequences to which those laws lead when modified by the extraneous conditions on which respiration depends.

(2nd.) But when the law to which we are conducted is altogether new, we cannot rely on its enabling us to extend our views beyond the circle of instances from which it has been obtained, unless it has previously enabled us to predict with certainty what will take place in cases analogous to those originally contemplated. In such inductions, therefore, one of the most decisive means of verification consists in the application of the newly-discovered law to extreme cases, with a view to ascertain how far its effect is general. For instance, though there could be no doubt, as Galileo had convinced himself, by allowing various substances of different weights to fall at the same instant from the tower of Pisa, that the accelerating power of gravity is the same on all sorts of bodies, yet as extremely light substances could not be tried on account of the resistance of the air, the law could hardly

be said to be established in its utmost degree of generality, until the invention of the air-pump had enabled it to be put to the test of an extreme case. A guinea and a feather, then, dropped from the upper part of a glass cylinder exhausted of air, struck the bottom at the same moment, and rendered further doubt on the subject visionary.

(3rd.) Where the inductions arrived at like those of concomitant variations belong to that class which require the application of the calculus, their verification cannot be considered complete without every case of trial is one of precise measurement, and without some of the instances chosen are of such a nature as to multiply any deviation till it amount to an appreciable result. Thus Kepler's three laws of planetary motions were only confirmed in the instance of Jupiter's satellites, by submitting the periodical appearances of these bodies to the test of quantitative laws: nor could even this computation be relied upon, till it was proved that if any deviation existed it must have become apparent in the result. The use of this branch of the verificatory process in harmonising individual inductions with the results to which the higher laws with which they are connected deductively lead, is beautifully exemplified in the mode by which Newton proved that the law of falling bodies, inferred by Galileo, was only another expression of the law to which his theory of gravitation had conducted him; viz., that the gravity of every material body is in the direct proportion of its mass. Now to ascertain this, a mode of experiment was required which not only neutralised the interference of the air, but also enabled the trial to be made a great number of times without loss or gain in the intervals. The object was accomplished by inclosing in a hollow pendulum at different times equal weights of the most various substances that could be found, and ascertaining the time required for the pendulum so charged to make a certain number of oscillations. Each substance having to fall and rise successively without loss of time through the same identical spaces, it is clear that any difference that might exist in the time of one such oscillation could not fail to be multiplied and become sensible in the result. But none such having been discovered, the law above stated was considered verified both in respect of generality and exactness.

We shall now proceed to illustrate the general principles laid down in this section by an inquiry into a cause[1] whose incomplete investigation requires the application of the main points on which we have insisted. Such a phenomenon is presented by dew. Now, at the outset of the inquiry, we must precisely determine what dew is, and separate it from rain, the moisture of fogs, evaporation of steam, and other phenomena of a kindred quality, and confine the term to what is really meant; viz., the spontaneous appearance of moisture on substances exposed in the open air when no rain or visible wet is falling (b. i. c. iii. § 1). In the second place, we must search for or endeavour to produce a phenomena identical or precisely analogous to the object of our inquiry (b. v. § 2), which occurs, for instance, in the moisture which bedews a cold metal or stone when we breathe upon it; in that which appears on a glass of water fresh from the well in hot weather; in that which appears on the inside of windows when sudden rain or hail chills the external air; in that which runs down our walls when a warm, moist thaw ensues after a long frost. Now all these instances agree in one point (1st meth.), the coldness of the object dewed in comparison with the air in contact with it. But in the case of night-dew, is it a fact that the object dewed is colder than the air? To ascertain this we need only place a thermometer in contact with the dewed substance, and hang one at a little distance above it, out of reach of its influence. The result has invariably decided the question in the affirmative. Whenever an object contracts dew, it is colder than the air (1st meth.). But is this chill an effect of dew or its cause? That dews are accompanied with chill is a common remark; but vulgar prejudice would make the cold the effect rather than the cause. We must, therefore, collect more facts, or, which comes to the same thing, vary the circumstances; since every instance in which the circumstances differ affords a fresh fact; and note the contrary or negative cases (3rd meth.).

Now, in the first place, no dew is produced on the surfaces

[1] See Wells on dew, Herschel's Study of Nat. Phil. p. 159, and Mill's System of Logic, vol. i. p. 491. We have principally followed the astronomer, who has invested Wells's lucubrations with such elegant features as might have seduced Plato into a study which he abhorred.

of polished metals; but it is produced very copiously on glass, both exposed with their faces upwards, and in some cases the under side of a horizontal plate of glass is also dewed, which last circumstance (2nd meth.) excludes the fall of moisture from the sky in an invisible form, that would naturally exclude the vulgar attribution of the cause. In the cases of polished metal and polished glass, the contrast shows that the substance has much to do with the phenomenon (b. v. § 2). Therefore, let the substance alone be diversified as much as possible, by exposing polished surfaces of various kinds. The result is a scale of intensity in the phenomenon (5th meth.), those polished substances being found to be most strongly dewed which conduct heat worst; while those which conduct heat best resist dew most effectually. Here we encounter a law (5th meth.) of the first degree of generality; but if we expose rough surfaces instead of polished, we occasionally find this law interfered with. Thus, roughened iron, especially if painted over or blackened, becomes dewed sooner than varnished paper. The kind of surface, therefore, has a great influence. Expose then the same material in very diversified states as to surface (2nd meth.), and another scale of intensity becomes apparent; those surfaces which part with their heat most readily by radiation are found to contract dew more copiously, and thus we obtain (5th meth.) another law of the same generality with the former, by a comparison of two classes of facts, one relating to dew, the other to radiation of heat from surfaces.

Again, the influence ascertained to exist of substance and surface, leads to the consideration of that of texture (2nd exten.), which presents us with remarkable differences on a third scale of intensity, pointing out substances of a solid texture, as stones, metals, &c., as unfavourable; but those of a loose texture, as cloth, wool, velvet, and others of a similar class, as eminently hostile to the contraction of dew, and these are precisely those which are best adapted to clothing, since they impede the free passage of heat from the skin into the air, so as to allow their outer surfaces to be very cold, while remaining warm within (2nd exten., 1st verif.).

Lastly, among the negative instances it is observed that dew is never copiously deposited in situations much screened

from the open sky, and not at all in a cloudy night; but if the clouds withdraw even for a few minutes, and leave a clear opening, a deposition of dew presently begins, and goes on increasing. Here, then, a cause is distinctly pointed out by its antecedence to the effect in question (2nd meth.). A cloudless sky is, then, an essential condition, or, which comes to the same thing, clouds or surrounding objects act as opposing causes. This is so much the case, that dew formed in clear intervals will even evaporate again when the sky becomes thickly overcast (2nd exten., 1st verif.).

Assembling all these partial inductions, with a view to raise from them a general conclusion, it may be observed that all the inferences we have made point to that first general fact—the cooling of the exposed surface of the body dewed below the temperature of the air. Those surfaces which part with their heat outward most readily, and have it supplied from within most copiously, become coldest if there be an opportunity for their heat to escape, without being restored to them from other objects. Now a clear sky affords such an opportunity. It is a well-known law, that heat is constantly escaping from all bodies in rays, or by radiation, but is as constantly restored to them by the similar radiation of surrounding objects (1st verif.). Clouds, therefore, act as opposing causes, by replacing the whole, or a great part, of the heat so radiated away, which can only escape without being replaced through openings into infinite space (1st verif.). Thus, at length, we arrive at the general proximate cause of dew, in the cooling of the dewed surface by radiation faster than its heat can be restored to it by communication with the ground, or by counter-radiation, so as to become colder than the air, and thereby to cause a condensation of its moisture.

Thus the inquiry may be said to terminate by resolving the laws of the phenomenon into two more general laws, viz., the radiation of heat and the condensation of invisible vapour by cold, which become in turn capable of similar investigation and resolution into phenomena of wider generalisation. The laws of radiation had, however, been previously established, and received no new confirmation by the explanation of this theory, which, indeed, they only tended to explain (2nd verif.): and the condensation of invisible vapour by cold had already

become a portion of physical inquiry. Thus, the explanation of the laws of nature only lead to the resolution of a sensible knot of complicated effects into others more simple but less known, and so far only substitutes for a mystery which has become familiar, a phenomenon still more strange. To explain natural laws means nothing more than to assign other laws of a higher character, which, modified by peculiar circumstances, will lead to the particular consequences they include.

§ 4.—*General Outline of the Inductive Method. Difficulties and Limits Attending the Application of its special Canons.*

From the example already given of Dr. Wells's theory of dew, may be obtained a correct idea of the relative functions of the different rules of induction, and the mode in which they generally combine in interweaving the partial inferences of which the texture of scientific evidence is composed. The process may be summarily collected under the following heads:—1st. The obtaining a precise idea of the nature of the thing whose cause we are in search of, by separating it from subjects which exhibit a superficial resemblance to it. 2nd. The collection and examination of every instance that seems to bear upon the inquiry, including those which manifest the property in question, as well as kindred instances in which the property is not produced. 3rd. The variation of these instances, to reveal the law which they suggest as the proximate cause, or the artificial production of others calculated to accomplish the same purpose. 4th. The connexion of such law with others of which it may happen to prove a special instance, or the pursuit of it into individual cases, with a view to ascertain if it rationally accounts for the peculiarities they manifest. Any law which concentrates within itself the united evidence of such an investigation, must be accepted as the real proximate agent of the phenomenon for which it accounts.

Hence it will be observed, that no single method is ever sufficient by itself to raise a law of high degree of universality. In the examination of instances where the law inquired into is modified by extraneous circumstances, each method is competent to draw whatever induction seems warranted by the circumstances of the case; but since

a law of any degree of generality embraces several of such inductions, the evidence by which it is established must include and harmonise all the methods, otherwise the law is liable to be overset, through covering more ground than its foundations are warranted to support. In the investigation of some physical laws, however, one method is more available than another, and that to a greater or less degree, according as the nature of the concomitant circumstances admit of their action. These laws it will be necessary to point out, with their correlative methods, and the limits which some branches of physical science oppose to their action even on the threshold of investigation.

The methods of induction explained in the last section proceed upon the assumption that every effect is so connected with a constant proximate cause, that it is impossible to meet with an instance of divorce between them; so that we may always infer, from the presence of the effect, the operation of the same cause we have previously assigned to it. Now we have already had occasion to observe, that this is by no means universally the case. The same effect may, and often is, generated by *different* proximate causes, especially where its nature is the result of many compound conditions—as death, motion, heat, moisture, &c., and this in so remarkable a manner, that the producing agents which alternately concur in the creation of the same property are frequently of a very dissimilar and heteroclite character. What conditions, for example, can be so various and changeable as those on which heat depends? It may be produced by friction, by electricity, by percussion, by chemical action, and the presence of the sun. To argue, therefore, from the sensation of heat, that any single one of these agents were, or had been, occupied in its production, would be illusory in the extreme[1].

[1] An error which Mr. Mill accuses Bacon with committing in his inquisition into the cause of heat. We do not think Bacon's mistake lay exactly where this distinguished logician places it. Bacon attempted to trace the different sources of heat to one common law. So far his investigation was scientific; but he entered on the task before accounting for the effects of the different proximate causes which produced it. Here lay his error, as we are not privileged to merge minor causes into higher generalisations before ascertaining their special laws. Mr. Mill says Bacon was wrong in seeking for an ultimate cause which might have no existence. But if this censure be worth anything, it would bastardise every attempt at scientific analysis.

We do not hazard the assertion that each of these proximate causes of the phenomena may be resolvable into one common property on which they ultimately depend, or that effects generally, which are dependent on different proximate causes, may not likewise be traced back to one source. Of ultimate causes, as such, science takes no account: she is entirely occupied with proximate ones, and since a variety of these may lead to one common effect, it becomes important to consider how this uncertainty affects her methods.

It is obvious that when one effect has a plurality of causes, the method of agreement must be put out of court, since we could not infer from the bare presence of a constant antecedent in the instances we had examined, that it alone had generated the single invariable consequent which accompanied it. But no other method is invalidated by it, at least in the single inductions we make concerning each special case. For if the constant effect varies exactly according to a direct ratio with the accompanying antecedent, or if we can produce two instances which differ alone in the absence or presence of the assigned cause, we need no further evidence that the antecedent produces the effect in the case in question. We can, indeed, proceed further, and generalise the inference, predicting that wherever the conditions are which we have discovered, the same effect must follow, though we cannot reverse the statement, and affirm the ubiquity of the cause with the effect. In cases where the plurality of the cause is doubtful, what amount of experience will warrant us to venture the latter prediction must be a consideration for a subsequent section.

But as the operations of nature are characterised by economical simplicity, diversity of cause is by no means the ordinary rule, and the uncertainty with which it surrounds the application of the first method can easily be dissipated by a proportionate multiplication and diversity of instances. It is no more possible that a single antecedent discovered in a crowd of most dissimilar cases should be attended with a constant invariable antecedent without a causal tie between them, than it would be for the same antecedent to vary in direct proportion with the same consequent, amid a number of unvariable phenomena without connexion with it. Such an element of doubt, therefore, only requires the method of

agreement to rest upon a proportionably greater number of cases than any of the others, in order to invest the results to which it leads with the same amount of scientific value.

The consideration of the different modes in which causes compound their effects, will help us to further distinctions with regard to the use of these methods, and conduct us to the limits of inductive inquiry. This composition resolves itself into two branches, each of which are in some measure co-extensive with chemistry and mechanics. When one effect is compounded of many causes, the result either manifests itself in a composition or mixture of the individual causes which enter into it, or leads to the formation of a new substance, having no analogous properties with the elements from which it sprung. For example, in the case of motion, if a body is propelled by two forces meeting it in transverse directions, it will describe the diagonal of a square, and be conducted to the precise point it would have reached had it been acted upon by the two forces separately. Hence, in this branch of the subject, if we happen to know the effects of the separate causes we can arrive deductively or *à priori* at a correct knowledge of the effect that will result in any given case from their conjunct agency. In the chemical branch of the subject the composition of causes is attended with results of an opposite character. If potash and tartaric acid be mixed together in certain proportions, instead of obtaining a mere mixture composed of the joint properties of both, we obtain a solid saline substance quite different from either potash or tartaric acid, and not betraying any sensible mark to lead to their distinction. Not a trace of the original properties is to be discovered in the compound result. This explains why mechanics is a deductive or demonstrative science and chemistry is not. In the one, we can compute the effects of all combinations of causes, both actual and possible, from the laws which govern those causes when acting separately. In the other, we are left entirely to experiment, every induction terminating with the peculiar combination which led to it: nor can it include other combinations in any generalisations until assured by experience of the actual truth of the facts whose recurrence under certain conditions it predicts.

Now, of these compound effects, those which follow

chemical laws are the most easy to investigate by the direct methods of induction; owing chiefly to the simplicity of their development, which arises from their ceasing to carry into the complex result the properties of the different causes which produced them. They appear, like ultimate properties, disinvested of the involuted web of causal agencies, and present marks so characteristic, that their presence cannot fail to be distinguished among a crowd of surrounding phenomena. The methods of induction consequently can meet with no other difficulty in their solution than the failure of instances to reveal their causes present, or the absence of artificial experiments to produce them. On the other hand, in mechanical composition the effects of the separate causes do not terminate and cease to form any part of the phenomena to be investigated, but carry their results onward until they intermingle with the homogeneous effects of other causes. They are no longer simple integers existing in a distinguishable shape, but appear as insoluble quantities, some of which cancel one another, while many others merge into one sum, forming altogether a result, between which and the causes that produced them, observation is often incompetent to trace any fixed relation whatever. Moreover, it is a common feature of these laws to have their causes counteracted, and exhibit no marks of action in many cases where they have spent their full effects. If two equal forces, for example, act upon a body in lines diametrically opposite, the body so impelled does not manifest the slightest tendency to motion, but remains where it was, notwithstanding the acting forces have each produced its own quantum of effect. Or if a force act upon a body which it is unable to move, we do not perceive any result proceeding from the operation of such force, although an effect has been produced in the tendency of the particles of the passive body to move in the direction of the impulsive force. But how can we expect to find the law of a tendency by an induction from cases in which the tendency is counteracted? Could the laws of motion have ever been brought to light from the observation of bodies kept at rest by the equilibrium of opposing forces? In this department of science the inductive methods are obviously inapplicable: we have no other resource than to study the effects of each cause separately, and to infer, by deductive

reasoning, the result that must eventuate from their combination in any given case. Happily Dynamics, which embraces the greatest branch of the latter kind of causal composition, is so far independent of the inductive methods as to have reached its highest generalisations, and to lack nothing in their application to particular facts, by the deductive method, than a further simplification of mathematical analysis; while the remaining branches, which play a great part in every science except chemistry and physiology, depend in a great degree on the experimental methods only, with a view to obtain accurate data to justify and extend the use of the descending scale of inference.

And even in the two sciences just mentioned, there are many phenomena which are amenable through a similar composition for causes to the same method, and the tendency which chemistry and physiology manifest to multiply laws of this kind leaves us not without a hope that they are destined one day to become deductive. Though it would be of course impossible to deduce all chemical and physiological truths from the laws or properties of simple substances or elementary agents, it is by no means difficult to believe what the general analogy of these sciences already points out, that such particular truths may be deduced from the laws which ensue when these elementary agents are brought together into some moderate number of simple combinations. The great law of definite proportions already has discovered a certain relation between the quantities of a compound and those of its elements, which enables us to predict, provided our data be accurate, the exact proportion in which two substances will combine before actual trial. And we are already in possession of some particular generalisations which indicate the possibility of forecasting similar results in relation to the qualities of compounds. We have also the law of isomorphism already alluded to, and the curious fact revealed by Berthollet, that two soluble salts mutually decompose each other, whenever the new combinations which result produce an insoluble compound, or one less soluble than the two former pointing in the same direction. In like manner the complicated phenomena of life may all be deducible from comparatively simple laws, which, though depending upon certain combinations of antecedents, may in more complex

circumstances be strictly compounded with one another, and with the physical and chemical laws of the ingredients. The details of the vital phenomena even now afford innumerable instances of the composition of causes; and in proportion as their laws are accurately studied, there is every appearance that more facts will be brought to light which will connect complex cases with higher generalisations, and legitimate a further extension of the deductive element.

Here we have arrived at a perfect type of those cases in which the inductive methods can be of little service, where an unknown multitude of clashing and combining agencies being engaged in the production of one phenomenon, require the aid of instruments to unravel, more subtile and diversified in their application, more potent and decisive in their results. In the physical sciences such are supplied by the calculus in its deductive range, and the ratiocinative process; but these cannot be applied unless experience furnish them with sufficient data on which to proceed, or unless, in case of the data being assumed, the result can be brought to the touchstone of facts, and clearly shown to accord with their actual combinations. In proportion as the experimental sciences display similar effects and allow their various conjunct results to be traced back, and, consequently, deduced from the separate action of the simple agencies of which they are composed, do they become deductive and amenable to the highest processes of generalisation.

§ 5.—*Nature of Scientific Deduction. Formation and Verification of Theories.*

We have already alluded to the employment of the deductive method as essential to the verification of single inductions when the law they reveal is found to be a mere exemplification of a higher law acting in combination with peculiar circumstances. Two cases in point occur in the inductive process which led Dr. Wells to his theory of dew. It is a law, for example, that moisture which falls from the sky never appears on the under surface of substances; so that the theory would be materially confirmed if an instance of dew could be brought which shut out that law as an acting principle. Such an instance was produced in some horizontal

plates of glass with their under surfaces dewed to the exclusion of the upper, which enabled Dr. Wells to infer that the fall of moisture from the sky could not have produced the phenomenon in question. Again, it is a well-known law that heat is continually escaping from all bodies by radiation, but is as constantly restored to them by similar radiation from surrounding objects. Now, if dew was caused by such a modification of this law as the theory purported, it is clear that in places where the sky was overcast and the neighbourhood much sheltered from the influence of the atmosphere little or no dew could be deposited; an inference borne out by actual observation, for dew is never copious in situations much screened from the open sky, and does not appear at all in a cloudy night. Hence the theory harmonised with the deductive inference to which the law led, and strengthened the series of partial inductions that pointed to it as the operating cause.

Hence it will be seen that the inductive and deductive methods are closely blended together in the successful process of scientific inquiry. We cannot establish, even by induction, any law of a moderate degree of generality without the assistance of its correlative method, nor can we proceed in the scale of descent unless the data from which we set out have been at some stage or other guaranteed by preceding inductions, except, indeed, we reason hypothetically, in which case the result will have to be verified by induction from the actual instances to which it leads. Thus Dalton could not have inferred that a complete combination between two elementary substances in chemistry would ensue when their weights were found in a certain definite proportion, unless by the method of agreement the law had been previously ascertained to occur in a sufficient number of instances to place its universality beyond the pale of doubt; nor could Newton have identified the central force of the solar system with terrestrial gravity without proceeding from a law, which, though proximately the fruit of a deductive process, could not have been received unless verified by facts based on the inductive method. The fact that the earth attracted the moon with a force varying according to the inverse square of the distance, and the proof that this would cause the moon to fall, were that luminary at no greater distance from

the earth's surface than terrestrial bodies, with a rapidity precisely equal to the increasing ratio of their velocities, could not have helped Newton to his object unless he had previously ascertained that the sun attracted the planets with the same force as the earth attracted the moon, by showing not only that the force in question led at once to the inference of Kepler's laws, but that no other supposition could lead to them. Thus, the path by which we rise to knowledge must be often ascended and descended before we can scale our way to any eminence, much less reach the summit. No great principle can be reached by a single effort, or by confining ourselves to one method. In every science stations must be established, and communications kept open between all well ascertained truths of law, that minor facts may be verified by the higher generalisations to which they lead, and the correctness of hypothesis decided by an appeal to inductive laws.

There is, consequently, no necessary opposition between deduction and induction. Both are essential steps in the process by which any law is reached of moderate generality: nor is there any reason why the physical sciences should be called inductive rather than deductive, unless, indeed, that the former element generally predominates at the earlier stages of their progress. The sciences, however, which have not got beyond their infancy, are correctly designated experimental, by way of contrast to that branch of physics with which deduction is principally concerned, simply because they include no cases of laws sufficiently general to admit of extensive ratiocination, and are consequently dependent on observation and experiment for new accessions to their store of truths. But in proportion as conclusions can be drawn in such sciences respecting cases of a new kind, by processes which bring those cases under old inductions, do they become deductive, and are open to receive the aids attendant on this method. Thus, when Kepler announced his three laws of planetary motions, astronomy could not be called deductive. The laws themselves pointed to no inference below them, unless movement in an elliptical orbit—a fact already ascertained by the inductive process which led to them. For the rest, they left the science where they found it; a mere mass of descriptive and statistical details, without any common bond or con-

necting principle between them. But when Newton showed that Kepler's laws were only partial inferences of a centripetal force, varying directly as the mass, and inversely as the square of the distance from the central power, he linked together a host of particular inferences, and established a principle which ultimately contributed to identify terrestrial with celestial gravity, and to account for all the motions, whether regular or anomalous, of all the bodies of the solar system. Astronomy, consequently, became at once eminently deductive: an arch was raised high in air which connected all the inferior stations which had been established, with the highest point of ascent. In the sweeping application of this principle to the deductive range of inference, no fact was left without its law, and no law but what became included in its wider proximate generalisation. Chemistry, on the other hand, though pointing to results which seem to promise a great extension and simplification of its complex laws, is still an experimental science, and is likely so to remain until some comprehensive principle like Newton's shall bridge over a vast number of the smaller inductions, and connect them through intermediate links with its most extensive inferences;—a principle, in a word, which should enable us to foresee the result of any new combination of elements previously untried, and to dispense with actual analysis in pronouncing at sight upon the ingredients of any new compound submitted for inspection.

It is at this stage of the sciences, when they are throwing off their experimental character, that the principles of number and geometry are instrumental in widening their bases and imparting to them the simplicity and generality of their methods. When laws act according to some numerical quantity, or their effect takes place in space, and consequently involve motion and extension; or when they exhibit variations of qualities, in exact correspondence to variations of quantity, the reasoning by which they are carried down to their individual limits may include among their premises all the theorems of mathematics from common arithmetic up to the calculus of variations. The application of such laws to particular objects consequently becomes multiplied in a proportionate extent, and since the truths of number already ascertained appear infinite, there seems no boundary to the extension of

those sciences which admit of their influence but the intricacy of the problems to which the expression of their data lead. The prolific generation of new truths, which proceeds from the conjunction of a science already deductive with so potent an agent as number, may be witnessed in the indefinite extension of the axioms of geometry, as soon as it was observed by Descartes and Clairaut, that every variety of position in points, directions in lines, or forms in curves or surfaces corresponded with a peculiar relation of quantity between one or two rectilineal co-ordinates in such a manner, that, if the law were known according to which those co-ordinates vary relatively to one another, every other geometrical property might be inferred relating to the quantity or quality of the line or surface in question. Thus it resulted that the axioms of geometry were taken out of mere lines and figures, and made co-extensive with the range of algebraical analysis, receiving an accession actual or potential of new truths corresponding to every property of numbers which the progress of the calculus had discovered or might in future bring to light.

To legitimise the use of this instrument, however, and to allow free scope for ratiocination, it is obvious, where particular results are to be investigated, that the general principle must rest on prior inductive or deductive evidence, or at least be the fruit of a well matured hypothesis, whose consequences are able to be tested by a direct appeal to facts. Lagrange, for instance, could not have been warranted to deduce all the known properties of sound from the laws of the propagation of motion through an elastic medium, unless it had been previously established by experiment, that every variety of sound was consequent upon a distinct and definable variety of oscillatory motions among the particles of the air. Where such preliminary principle is not reached, we may indeed assume one, but the details of the hypothesis must not only be shown to accord exactly with all the facts which it presumes to explain, but it must likewise be proved that no other supposition could account for them. Thus it would not have been competent to Newton to assume that the moon was drawn to the earth by a force varying as the inverse square of the distance, simply because that ratio would allow him to accoun for the falling velocity of terrestrial bodies by a

similar attraction and identity of gravity with the central force of the solar system. For in that case, he could not subsequently have proved that no other supposition of a force was able to account for the law in question, save one extending to the moon, and proportional to the inverse square. In the proof, however, of the existence of the centripetal force, varying in the same ratio, the assumption with which he set out, viz., that the force which deflects a planet from its rectilineal course and makes it describe a curve round the sun, is a force tending directly towards the sun, was perfectly legitimate. For he not only demonstrated that the hypothesis which the nature of the phenomena had suggested led by direct deduction to the inference of Kepler's laws, but he also proved that no other supposition could lead to them. Now Kepler's laws were facts resting on the strongest inductive evidence. The case, therefore, was completely made out, and the hypothesis became a law established by the method of difference.

Owing to the limited extent of the resources on which the inductive processes depend, there is no greater instrument for the discovery of scientific truths than the formation of legitimate and well matured hypotheses. They allow pure reason to wing its flight through the realms of science emancipated from a servile attendance on facts, and to assert its prerogative over them by interweaving on its way that multiplied and ever diverging thread of argument, through which a few inductions are connected with a labyrinth of laws, and nature coerced to reveal her mysteries, not one by one as in the case of tardy experiment, but to surrender up hosts at once as under the talismanic spell of a superior spirit. But in order to effect this object, the law must be so completely made out as to render it impossible, consistently with previous inductions, for any other theory to be true. Reason must not do her work by halves. She must show that out of all possible suppositions which the case admits of, the theory which she produces, is the only one that exactly fits into the exact frame of the phenomena involved in the inquiry. Now this can hardly be, unless we have good grounds for the belief that the causes which the hypothesis assumes actually exist in nature, and perform a part in phenomena analogous to the laws we would render an account of. Thus, Newton correctly assumed that the planets

were attracted towards the sun by a force exerted in the centre of their orbits; for, in every instance of similar motion around him, of slung stones, of balls, or wheels revolving round a fixed point, he never failed to observe a material tie existing in that direction, and could not imagine that the bodies in question were retained in their circles by any other force. The hypothesis consequently involved what he designated a *vera causa*, or really existing cause producing effects in nature similar to the phenomena he contemplated, and limited the range of admissible suppositions to the various possible numerical relations between the variations of the distance and the variations of the attractive force. But when Descartes ventured to explain the planetary movements by the supposition of vortices acting in accordance with the known laws of rotatory motion, he attributed a series of effects to a cause which not only produced no analogous instance in nature, but whose existence could in no single case be demonstrated. Fictitious or random suppositions, even if they coincide with fact, cannot be supposed to explain them. The inferences to which they lead, though ever so plausible, will partake of the doubtful character of their origin, and as long as nature refuses to decide upon their existence, no striking illustration of their coincidence with actual facts can furnish more grounds for belief in their reality than a vague probability[1].

It is not, however, to be inferred, because we know of no case in which the cause assigned by the hypothesis produces the effect in question, that the supposition must be thrown away as idle, or regarded as absolutely incapable of being transformed into actual reality. Nature works so secretly, and produces even similar effects by agents occasionally so novel and diverse, that it would be the height of presumption to suppose that she could not operate by other causes than those of which we were already cognisant, and that the augmentation of future coincidences between the doubtful agent and the visible effects might not at some future stage transform the alleged hypothesis into fact. Even if this desirable result should not happen, yet if the hypothesis enables us to group together several laws under wider gene-

[1] These remarks may appear trite, but we refer the reader to b. i. c. iii. § 4 for the baneful influence which such visionary hypotheses have exercised over science.

ralisations, and sets experiment to work by suggesting modes of action analogous to what obtains in similar cases, it can hardly fail to promote the purposes of science, by bringing to light many facts which would have lain concealed were it not for the presumed proximate causes or analogies it had pointed out. The undulatory theory of light is one of the most favourable instances of hypotheses of this character. Considering the manner in which this theory ascribed the transmission of light to the vibratory motions of an elastic ether, Dr. Young was led to infer, from an analogous property of the transmission of sound through a similar medium, the beautiful law already adverted to of the interference of the rays of light. But it is not to be lost sight of, notwithstanding this theory very plausibly accounts for all the known properties of light (and might consequently be supposed, should it not prove an actual statement of the proximate causes of optical phenomena, to be in some manner connected with them, or at least to run so close a parallel with them as to admit of some expression common to both), that the Newtonian theory, which sets out from an opposite point of view, is capable of rendering a no less rational account of all the facts embraced by the same science, if we admit the very reasonable supposition advanced by M. Biot, of a rotatory motion of the particles of light about their axes. These apparent agreements and clashing discrepancies ought to make us extremely chary in placing any strong reliance on theories, and refuse to regard any hypothesis as legitimate, at least where a cause is to be investigated, unless the cause assigned be already known to produce the effect in question, in which case the supposition will be limited to the precise mode of the dependence; or, in other words, to the exact law according to which the effect varies with variations in the quantity of, or in relation to the cause.

It may happen, indeed, that the supposition do not relate to causation, but only to the law of correspondence between facts, which being effects of one common cause, accompany each other in a certain fixed proportion. But as the laws of such variations are always open to precise measurements, there is no difficulty in bringing any hypothesis concerning them to the touchstone of facts, and thus pronouncing on their reality. It was known, for example, that the direction

of the line of refraction varied in a certain proportion with that of incidence, but the different false hypotheses by which Kepler sought to discover the law of the variation, were cast aside as soon as they were brought to the test of measurement, and none subsequently framed stood its ground for the same reason, until Willebrod Snell pointed out the angular proportion of the two rays, and M. Fresnil showed the law, together with that of the deviation of the extraordinary refracted ray, were necessary inferences from higher generalisations of an indisputable character.

We need hardly say that it is indispensable to the two conditions already enumerated for transforming hypotheses into correct exponents of general laws, that they coincide with all the observed facts and inductions previously known which those laws include. Hence the comparison of the inferences to which they deductively lead, with the mass of established truths which every important theory embraces, is one of the most secure means of their verification. When the cause assigned by an hypothesis is already known to produce similar effects to those attributed to it, and is found to agree with all the facts included in its generalisation, it can hardly fail to be true, especially if the previous inductions arrived at be of a very diverse character. In such case the hypothesis will rest on the method of agreement, and the number of inductive inferences which it meets, will, therefore, be required to spring from such different quarters as to place it beyond doubt that any hypothesis, bearing the character of a *vera causa*, could fit them without being the actual agent in question.

Hypotheses, however, are not available in all subjects. In many the general principle to be reached can only be gained by ascending inductively from the minor to the more general laws which it includes; which ascent is not without its advantage in enabling us to perceive how laws which we had previously regarded as unconnected become particular cases, either one of the other, or each of one still more general, and at length blend all together in the general principle, which is the object of our search. If chemistry ever pass the limits of an experimental science we fear it can only be by a process analogous to this. The proximate generalisations in which its complex laws are now commencing to resolve themselves

are so unlike any agents which we could have suggested *à priori*, as to make the use of hypothesis on any large scale in this science visionary in the extreme. Where the principles of a science are peculiar to itself, and exhibit no analogous laws, or facts to other sciences whose agents are more thoroughly understood, the condition of hypothesis is desperate. We have no choice but to proceed in tardy gradation and toilsome ascent from law to law, until we trace out a general principle that will allow ratiocination its deductive range.

It must, in fine, be noted, that in all cases of reasoning from general theories, whether obtained by the inductive or hypothetical process, every step of the ratiocination must be verified, if possible, by an appeal to facts; since, even should the theory prove true, an error committed in pursuing it into detail would of course lead to wrong inferences, and invalidate the general statement in which it was expressed. An apposite illustration of the necessity of this step is to be found in Newton's Theory of Sound, which, although accounting correctly for the general principle, and leading to a numerical conclusion for the actual velocity of sound which agreed in general respects with reality, yet was found defective in an essential point when Lagrange looked more closely at the facts, owing to one or two important considerations being overlooked by his predecessor in pursuing the subject into its minor details. Hence, it is indispensable to the secure completion of the deductive inferential process, that all the details to which it leads should be verified by an extensive comparison with observed facts.

§ 6.—*Empirical Generalisations; Theory of Probability; and Analogical Evidence.*

So far we have considered the methods by which concealed laws, or universal propositions, admitting of no exceptions, are hunted out and demonstrated: but in addition to the positive truths, of which natural philosophy is constituted, there are a large class of irregular occurrences in nature that depend on causes so variable and uncertain as to incapacitate science either from pronouncing on their anterior conditions or predicting their return in any determinate instance. These

it is necessary to invest with as much scientific certainty as the case admits of. Though we cannot reclaim them entirely from the dominion of doubt, we may, nevertheless, ascertain the precise extent to which they are to be trusted: and, in many instances, raise important conclusions from them of a practical nature.

The most favourable of these cases meet us in the shape of phenomena, whose concomitant occurrence is so frequent as to warrant the inference of some antecedent connexion between them, without affording us any secure ground for affirming the manner of its existence. Thus, the fact that most dark-eyed persons have dark hair; that most Swedes have light complexions; that most stratified formations contain fossils; that most mineral springs possess salt, and other coincidences of a similar character, being the effects of latent conditions which are liable to be marred in particular cases by uncertain laws, do not present any ground on which science can erect a proposition of more than probable universality. The time may arrive when the condition, both of their occurrence and failure in every known case, will be traced to the action of laws of a distinctive character. At least, the present advance of science is raising many similar coincidences out of the category of empirical generalisations, to the rank of scientific truths: but as fast as science proceeds in this direction it brings to light other coincidences of like nature; so that it is never likely the philosopher will lack occasion to apply them in evidence, or that cases will not continue to occur in which they alone will constitute the only landmarks by which he can guide his way.

Now, it is obvious that until the conditions on which such coincidences depend are in whole or part laid bare, that we can place no further reliance on them than simple experience warrants. If we have observed that nine Swedes out of every ten have light complexions, the probability that the next Swede we meet will possess that feature will of course be in the same proportion. There are, however, some empirical generalisations whose anterior conditions are in some degree known, and whose truth, therefore, admits of prediction from another source. For example, it may be ascertained that most Prussians are arithmeticians, not only from personal observation and the reports of travellers, but

also from the fact of government schools existing in that country, to which every parent is obliged to send its offspring for a certain period, and in which the science of number is taught. The approximation to universality may consequently be easily calculated, without depending on a single result of experience, by allowing for the casualties of sickness and incapacity, within reasonable limits of error. Where the marks of the individual coincidence are latent, as in the latter case, we can sometimes ascertain whether the particular instance of the generalisation is included under it, by other marks which lead to its recognition. Thus, were it required to be known that a particular witness in any case was an instance of the empirical proposition that most men speak truth, we need only ascertain his general character, and the bearings of his testimony on his own interest, to make up our minds with sufficient certainty on the subject.

Where the coincidence, however, is so rare as to create doubt as to its dependence on any recognised law, or to lead us to attribute its origin to mere casualty, notwithstanding a similar rule holds, it is necessary here to point out some particular cases of its application. Suppose, for example, the object of inquiry be the connexion of rain with a particular wind; it is not sufficient to observe the number of times this phenomenon occurs with one wind more than another, but we must also take into account the relative proportion of periods in which the other winds blow. If a west wind blows twice as often annually as an easterly wind, which is the case in England, we have no reason to infer that rain co-exists with the former wind through some law common to both, which does not obtain in the latter, simply because it rains twice as often with the first wind as with the last. But if it rain more than twice as often, we may conclude that there is some cause in nature tending to produce both rain and a westerly wind, or that a westerly wind has itself some tendency to produce rain. But should it rain less than twice as often, we may draw, for the contrary reason, a directly opposite inference. Hence, if we pursue the inference which points to some kind of connexion between a particular wind and rain, we generally find the cause to lie in the nature of the earth's surface over which the wind passes; those which have a long tract of water to sweep

over, as the south-westerly, being generally accompanied with wet; while easterly winds are dry, on account of the arid continents which prevail in that direction. But as we do not know how far these causes affect the phenomena in question, or how much they are assisted or marred by other causes, unless by experience; the coincidences they exhibit can only be regarded in the light of an empirical law, and their effects predicted within a proximate degree of exactness by the method already given.

The largest number of empirical generalisations embrace those phenomena which are conjointly the result of law and casualty, or in which the effects of casual conjunctions of causes are habitually blended with the affects of a constant cause. To ascertain the precise effect that ought to be ascribed to the cause invariably acting, as it is impossible to proceed according to the ordinary method of eliminating the action of the inconstant agents, our only resource is, to observe the variations which arise from their combination with the constant cause, and strike an average of the mean result. Should the trials prove sufficiently numerous as to include all the various states in which the capricious causes enter into combination with the invariable one, any further repetition of the experiments will only exhibit the same fluctuations, reducible to the same fixed average; so that we cannot go astray, if we assign the mean point attending all the sets of experiments to the presence of the constant agent alone capable of producing it, while we attribute the oscillations about it, to the casual influences which modify its action. For example, the state of the barometer at any particular period depends upon the air's gravity, which is liable to be modified by a multitude of capricious agencies,—such as clouds, rarefaction, evaporation, and the like; but if the fluctuations of the quicksilver be regularly noted, they will be found to be reduced to a small number, periodic in their occurrence, and constantly oscillating about a certain fixed point. The conclusion, consequently, is irresistible, that the mean height is to be attributed to the ordinary gravity of the atmosphere, and the periodic fluctuations to the daily interference of some constant agent with its natural density; which, on examination, proved to be the rarefaction of the air, occasioned by the increase of tem-

perature as the day advances. The inconstant fluctuations were then set down to the inconstant agents which produced them. It is by such observations we are enabled to ascertain the sun's medium heat at any point of the earth's surface, and the exact level of the sea on any particular coast, or the height at which the water of the ocean would stand if undisturbed by winds, waves, or tides. We also afford an example of the same method when we repeat an experiment, in order to escape the unavoidable errors of each individual experiment, by taking the mean of the different results.

From the discovery of the cause of the periodic fluctuations in the barometer, it will be seen, that when we are not aware of the presence of a constant cause in the anterior conditions of the effect, it may be discovered by striking a similar average of the mean result. For in that case, if the effects of the different causes do not cancel each other, but continually oscillate about a certain fixed point, we may infer the presence of an invariable antecedent among the anterior conditions, and detect that agent by some of the scientific methods already treated of. In this manner loaded dice may be discovered. For if, after a sufficient number of throws, we do not find the average of the particular results to balance each other, but exhibit a preponderance in favour of some particular throw, we may infallibly infer that some constant cause is acting in favour of that particular throw, and the precise amount of its influence. Hence we may conclude, with the same degree of assurance, an invariable agent to be absent among the anterior conditions when the average result is zero, and attribute each individual instance of the effect to pure casualty. But in these cases it remains to be determined, firstly, considering the average results of the coincidences of a sufficient number of trials, or the anterior cases possible, what is the amount of probability with which a particular instance may be inferred; and, secondly, with what amount of probability, in the case of several causes to explain a given effect, but of the presence of which in this particular case nothing is known, may this effect be assigned to any one of these causes.

The principles on which these problems depend for solution are laid down in a refined branch of mathematical

inquiry, called the doctrine of probabilities, and may thus be summarily stated[1]: the probability in favour of the occurrence of any particular instance out of the antecedent possibility of a multitude of others is, in the ratio, between the number of cases in which the event occurs, and the sum of all the cases, including those in which the event occurs, and those in which it does not occur; or when the anterior conditions are known to be equally possible, in the ratio which the entire number bears to the single condition. Thus, in play at cross and pile, the probability of cross is one half, because it is found on an average that cross is thrown about once in every two throws; whereas in the cast of a die the probability of ace is one-sixth, because in every hundred throws ace will be found to comprise one-sixth of the number. Secondly, the probability that the effect was produced by any one of the unknown causes which might have been in operation, is, in the ratio of the probability of the cause, multiplied by the probability that the cause, if it existed, would have produced the effect. Suppose, for example, that a woman was found drowned in low water: if the spot lay on any part of the sea-coast, three possible causes suggest themselves as the only agents by which the circumstance could be produced. First, the person slipping off the beach in a state of stupor or intoxication, and not having sufficient self-control to recover herself; or falling in while the tide was sufficiently high to drown her: secondly, the being drowned at sea, and subsequently cast ashore: thirdly, an act of violence, by which she was detained under water until suffocated. Now, if the woman was seen a few hours previous, perfectly rational, proceeding, during the ebb of the tide, in the company of a man in the direction of the locality where her body was discovered, and if a shriek was heard shortly afterwards in the neighbourhood whence they had proceeded; if, in addition, it could be proved that the man had been recently engaged in violent altercations with the woman in question, a strong case of probability, almost amounting to circumstantial evidence, would be made out in favour of the cause last mentioned. The second cause would be put out of court; the only doubt left in the case being that created by the first supposition that she had strayed some distance from her attendant, and having fallen into the sea

[1] Essai Philosophique sur les Probabilités, par Laplace, pp. 18, 19.

during a fit, perished before he could reach her; a supposition which, remaining circumstances taken into account, is hardly appreciable, when compared with the culminating probabilities on the other side of the question.

In the first case the causes to which the effect could be attributed were neither equally likely to have existed, nor equally certain to produce the effect. Had the woman been attacked with epilepsy, for the first time in her life, the probability that the fit would have thrown her on the beach, is much stronger than it should have caused her to be immersed in the sea; and even in the latter case, the probability that she should have been drowned before her companion reached her, is fainter still. The first cause, therefore, is made up of a series of very faint probabilities, which weaken each other in multiplied proportion, while the last cause admits only of one probability, and that, when blended with the adjacent circumstances, of a very strong character[1].

There are two other cases of the second theorem of very common application in judicial and scientific inquiry, viz., where the supposed possible causes, though equally certain to produce the given effect, are not equally certain to have existed in the case in question; and where their existence is equally certain, without being, under the circumstances, equally likely to have produced the effect. But in these cases, the probability in favour of any one cause will, of course, only lie in the ratio of their unequal probabilities. Thus, if one cause existed twice as often in nature as another, that is, occurred two hundred times where the other has only existed one hundred, and that one or the other must have existed where a certain effect has been produced, the probability in favour of the more frequent cause being the agent in question would be in the ratio of two to one, which is the ratio of their antecedent probabilities. Suppose, on the other hand, that the causes, though equally frequent, are not equally likely to have operated in one particular case; that, for example, out of three times that one cause occurs, it produces the effect twice for the

[1] It may be in the recollection of the reader that the probabilities on the side of the last cause were so culminating as to lead the jury to convict Mr. Kirwan, whose case is here summarily stated; but that the extreme penalty of the law was subsequently commuted, on account of the slight element of doubt that still remained in favour of the first supposition.

other's once, it is obvious that the antecedent probability in favour of the more frequent cause will be as before, in the ratio of two to one. The third case is but a compound of these two, where the unequal probabilities of each set of causes are multiplied or compounded together, and the balance struck in favour of the greatest probability.

Another class of inferences, which lie equally out of the range of direct scientific methods, and rest to a great extent on probable evidence, are those which we draw concerning the state of nature in circumstances, times, and localities, to which our observations have not extended, either through the durability which nature manifests throughout all her works, or from her tendency to bring about similar effects by similar agencies, and to work out her ends by designs which leave no arrangement half completed, or void of the object it was intended to meet. For example, from the fact that the sea has gained one hundred yards on the Sussex coast within the last century and a half[1], we conclude that it will continue to advance in the same proportion in succeeding years. Again, because day and night on our globe depend on the periodical passage of the spectator into and out of the earth's shadow, consequent on the earth's rotation and the illuminating property of the sun, we conclude the same phenomenon occurs with the other planets, which also revolve on their axes, and possess the sun's light in similar degree. In like manner, because the earth has never swerved out of its orbit, or exhibited any oscillations in its course destructive of its present internal economy, since the memory of man, we find no difficulty in believing it will continue to preserve the same beautiful order throughout all coming time. It is also no uncommon thing to draw analogies between the condition of other planets and this earth, with a view to obtain evidence of the nature of their inhabitants and their internal structure.

Now each of these, and similar cases of inference, are to be received with different degrees of probability, according to the amount of evidence in each case, and the limits of time and space to which each inference extends. It is obvious that with regard to the succession of day and

[1] The town of Brighton of Elizabeth's era is now deep enough under the waves, and the erosion of the sea on the adjacent cliffs is noticeable every year.

night in the remaining planets of the solar system, the supposition is of the strongest character, bordering in fact on a complete induction; but if we extend it to other spheres which revolve on their axes, the inference descends lower in the scale of probability, since we are not certain, on account of their absence from our system, that their rotatory motion may be accompanied with the illuminating properties of another sun, so related to them as to cause the phenomenon in question. Again, it is an inference resting upon the strongest grounds that the sun will rise to-morrow, and the earth continue its usual daily round; for both have continued to do so for the last five thousand years; and we know the laws on which these occurrences depend have not exhibited the slightest degree of deterioration in the interval. The supposition, therefore, that these agencies will be counteracted to-morrow by some cause, the effects of which have not appeared for five thousand years, and whose approach we have not the slightest grounds to anticipate, so far transcends human conception as to be considered an impossibility. The effects of no cause that science can take into account, which had not been perceptible for five thousand years, could in one night grow up to such startling magnitude as to become overwhelming. But if we extend the inference from to-morrow to this day ten thousand years, the inference loses its conclusive value; for there is nothing which is not perfectly consonant with our idea of causes to hinder the belief that a cause, which for five thousand years had produced no sensible effect, might produce a very considerable one at the end of ten thousand.

In the inference from analogy, the strength of the probability will depend upon the extent of ascertained resemblance, both compared with the amount of ascertained difference and taken in connexion with the extent of the unexplored region of unknown properties. Thus, in ascertaining the amount of probability in favour of the moon being inhabited, we must not only take into account the general points of resemblance between it and the earth, in its being a solid, opaque, and nearly spherical body, containing active volcanoes, and receiving heat and light from the sun in about the same quantity as the earth, and revolving on its axis; but we must consider its comparatively smaller dimensions, and the differences it exhibits in having its surface more unequal, and apparently volcanic throughout—in having no atmosphere sufficient to re-

fract light—no clouds, and therefore inferentially no water; and strike the balance according as the resemblances or differences predominate which bear upon the subject for decision. If mere point of similarity between the moon's and the earth's internal economy were in question, it is obvious, according to the above observations, the probabilities would about balance each other. But when we consider that some of the discrepancies in the moon refer to those objects which are found indispensable to animal life on our globe, we must conclude that if inhabitants do exist in the moon, the conditions on which their life depends differ considerably from those which obtain on the earth. There are, however, other bodies in the solar system, between which and the earth there is a much closer resemblance, which possess an atmosphere, clouds, and water, and which exhibit strong indications of snow in the Polar regions; while as the ascertained differences only refer to their average light and heat, their velocity of rotation and intensity of gravity, and similar unimportant circumstances, the argument of analogy presents a striking preponderance on the side of an internal disposition of parts analogous to the earth, and in favour of their being similarly inhabited. Nevertheless, when we consider the immense distance of these planets, and contrast the infinite number of properties they possess, of which we are entirely ignorant, with the few we know, we must confess this probability dwindles down to an almost inconceivable value.

CHAPTER II.

METHODS OF THE MORAL SCIENCES.

§ 1.—*Nature of the Moral Sciences. In what respect their Methods differ from the Physical.*

We intend to devote this chapter to a succinct analysis of those methods by which truths are reached, appertaining to the social, mental, and spiritual constitution of man, in contradistinction to those which belong to the physical world. The subjects of these methods not only differ from those comprised in the last chapter by the whole diameter of mind and matter, but are hardly at less variance with each other. The two great branches of the spiritual sciences, theology and ethics, being exclusively founded on revealed truths, and

the universal principles of the natural law, are directly amenable to the geometrical or abstract deductive method, which, from a few aphorisms or salient propositions, deduces the complexity of truths of which those sciences consist; while sociology comprises a group of sciences depending for the most part on the action of men on circumstances, and the action of circumstances on men, the laws of which can by no means be learned *à priori*, but must be gleaned from an accurate examination of the past, and referred as a kind of *axiomata media* to the higher principles of human nature. Hence the methods of this division of the subject referring to past sequences between successive stages of phenomena, are very closely allied to those of physical inquiry; while those, like theology and ethics, appertaining to inferences from laws already discovered, which admit of no modifying or neutralising forces, but demand ubiquitous enforcement, are open at once to the sweeping range of direct deduction in its most obvious and least intricate form. Such sciences do not comprise relations between successive phenomena, but mere interpretations of universal formulas to meet every variety of case which the intellect may devise for their application.

Mental science, or psychology, is another department of this division, the laws of whose sequential phenomena for the most part are also to be gleaned from experience; but whose co-existing principles are obtained by a deep analysis of the individual consciousness, and educed by deductive sequence out of the primordial elements of the human mind. The former branch of psychology is connected as an art with education; the latter with the inferential process, which, true to its *à priori* character, was matured[1] as soon as the human intellect began to exercise the reflex principle; while education, depending on experience, is daily adding to its past results. This science consequently is open to receive the double aids of the experimental and abstract deductive methods, though little has yet been done, however much may have been attempted, to harmonise the truths collected from these two sources[2].

Legislation, which belongs to the sociological branch, is not amenable to the corresponding method, its leading principles

[1] By Aristotle. [2] Dugald Stewart's Philosophy of the Human Mind is the leading work of this character.

being deduced from the highest ethical laws, or rather being so many practical inferences from those laws, to suit the various occasions which arise for their application in civil society. As such they are strictly amenable to the abstract deductive method, and were, in fact, so intended to be treated by Lord Bacon in the heads of his fountains of equity[1].

These sciences, so apparently diverse, have a close affinity to each other. Ethics with psychology, forming by their conjunction the science of human nature, may be said to stand in the same relation to the sociological sciences as mechanics to astronomy. They comprise the simple law of which the latter sciences only afford the concrete exemplification in all the diversity of circumstances in which human nature has been placed. The highest results of the sociological sciences are therefore only *axiomata media*, or laws derived from the fundamental principles of ethics and psychology, and when unresolved into them, must be regarded as so many unverified and consequently empirical generalisations. Legislation is only a similar offshoot of the natural law; and since human nature, which includes the whole, is but a direct emanation from the Deity, theology may be said to be the fountain, or parent source of the rest.

While, however, there exist this close relationship between the several groups of these sciences, they present, by no means, a state of finish proportionate to their rank; nor, until the leading branches are in a more forward state, can we anticipate any large development of the laws of the complex phenomena to which they lead. While the science of mechanics was in its infancy, astronomy, which presents only a concrete exemplification of its laws, could not propound a single generalisation to be depended upon with any degree of assurance; and while the laws of mind are for the most part obscure or uncertain, we cannot rely upon any axiom that sociology may furnish beyond the instances in which its truth has been observed. The moral sciences, instead of being developed according to their rank in the scale, owe their expansion more or less to the extent of the *à priori* element in them, those depending on experience being the slowest in pro-

[1] De Augmentis, b. vii. Bacon had, however, during his solicitorship, written a treatise on English laws in exemplification of the inductive method.

gress and the most tardy of appearance. While ethics have reached a high degree of perfection, the laws of mind are a blank; while legislation has emulated ethics in extent of refinement, the science of social progress has hardly burst from its shell.

Combined with the disadvantages produced through the absence of proportionate development between the higher and lower groups of the moral sciences, there arises the startling anomaly of the widest diversity of opinion between large masses of men, even with regard to the fundamental axioms and derivative principles of those which are in their more advanced stage. In physics this is never the case with sciences that have advanced beyond the empirical stage. In astronomy, indeed, there are a few temerous enough to confront the Newtonian mechanics, but with the generality of civilised communities the Principia is taken as a correct exponent of the truths it endeavours to demonstrate, and this to so universal an extent, that the philosopher who rises to impugn them, succeeds in nothing but the demonstration of his folly[1]. With theology and ethics, and even political economy, one of the sociological branches, the case is far otherwise. Every person thinks himself at liberty to propound what opinions he chooses concerning these subjects; and, unless he belong to a certain school whose tenets on the leading points he accepts as irrefragable, every new writer generally sets out with the Cartesian principle of pulling down whatever has been previously erected, and clearing the ground for a new structure upon foundations for the most part at variance with those assumed by his predecessors. If his labours are characterised by systematic thought and bold flights of genius, he also succeeds in establishing a school, and instead of advancing the science upon which his mind has been concentrated one step onward, he

[1] The censure in the text only applies to those who admit the reality of celestial phenomena as implied both in the Ptolemaic and Copernican systems, while they ignore the superstructure which has been raised upon them by Newton and his successors. Of course, with respect to those who, like Bishop Berkeley and the present Cardinal Archbishop of Lyons, deny or throw doubt on the reality of the Newtonian premises on purely metaphysical grounds, the author ventures no reproof, though he respectfully adduces the reasoning in b. v. c. iv. § 3, as a complete answer to what has been advanced on this side of the subject.

has only increased the diversity of lights in which the same subject may be viewed. This divergence of opinion, between men of eminently scientific character, upon moral subjects has introduced among the unlearned classes of society the same fluctuating and conflicting views, and led them to consider moral topics, as much open to their lucubrations as the most inferior subjects upon which their minds can be employed. A man who would deem his ignorant neighbour mad were he to speculate in sober earnest on the higher principles of acoustics or thermology without knowing anything about their elementary properties, pays him the greatest attention when he chooses to discourse on the highest functions of government, or ventures to propound the principles by which churches and empires should be governed. On every subject respecting man, religion, and society, conceit of knowledge still reigns without the reality, and if Socrates were in this age to descend into our market-places he would encounter the same dogmatic assurance as in his own.

Such clashing variety of opinion upon the most elementary principles of the different moral sciences at once arises out of, and is daily increased by, the obscure character of psychological laws and the capricious action of human volition. Physical laws may often be obscure, but their effects admit of certain calculation; and the order of sequence, being constant and inevitable when once discovered, enables us not only to predict the future, in any given instance, but also to reconstruct the past. Astronomy, for instance, will afford us data for calculating the precise conditions of the heavenly bodies at any distant epoch, already elapsed, or in the womb of futurity, and that to so great an extent that even were all the astronomical archives burnt they could be completely replaced, and the past history of the heavens entirely supplied by the observation of the present. But with moral phenomena the case is otherwise. Here the chief motive power is mind, and we are not only ignorant of the laws through which it manifests its agency, but the order of its production is so irregular that we can never reckon upon the precise quality or degree of its action. Were psychological laws discovered, at least in sufficient abundance to verify many inductive generalisations in sociological science, still there arises the question, in extending those laws to future cases, of the exact force in which they will act. Now on this very hinge turns the fate of man

and the destinies of nations. No psychological revelations that man can expect to discover could have predicted the advent of those minds who have established religions, overthrown empires, founded dynasties, pulled down altars, or reformed creeds. This class of minds are distributed over the masses of generations by no presumable law that we can discover, but in the most anomalous and confused manner. Occasionally their appearance is separated by centuries, sometimes by gaps of years; now they come in clusters, and then they stand alone. But whenever they appear, revolution of language and manners, creation and overset of institutions follow; conjoined states are erected into new nations, and distinct empires fused down into one. Hence were the laws of mind known, and the phenomena it manifests as subject to the regular action of causation as the creatures of the material universe; yet the uncertainty alone of the quality of the agent would render any calculation, founded upon them for any distance of time, chimerical in the extreme.

Although it is a principle of our nature to assign to everything an efficient cause, yet so difficult is the task, in moral inquiries, of tracing any proportion between the apparent force of any moral causes we may select and their known operation, that we are often obliged to deliver up that operation to chance, or, more rationally, to the irresistible hand of the great Disposer. The death of a man at a critical juncture, his disgust, his retreat, his disgrace, have brought innumerable calamities on a whole nation; a common soldier, a child, a girl at the door of an inn, have changed the face of fortune and almost of nature. The effects to which such slight incidents led, may, indeed, be traced through the intervening series of eventualities which generated the result, but these are of so casual and multifarious a character, and so much depend at every link upon the determining agency of the will, that to attempt to found upon them any conclusion of a scientific nature, either for future guidance or present application, would be a waste of thought. Such cases are never likely to happen again, and even were their occurrence possible, no power short of omniscience could enable us to grasp all the conditions upon which each step of the sequence would eventually depend, and forecast the result. The will, which is the deciding agent in such circumstances, is no doubt strongly influenced by motives, if not completely governed by them; but we have

no power to calculate its action in a single individual under any trying circumstances, much less in cases where a thousand volitions are concerned. The rules of causation may hold, at least to an extent sufficient for the application of scientific methods, but we lack the power to get at the conditions upon which the effect depends. The task of diving into the human breast and tracing the crowd of agencies which are controlling each volition, is even too great for its owner, who is often uncertain enough of the issue; but the insuperable difficulties which hinder an external observer from grasping the same conditions, become multiplied in infinitesimal proportion.

Even in subjects which have no relation to sequence, as theology and ethics, the irregular agency of the will is manifested in interfering with the inferential process and leading the mind to modify or oppose conclusions which are at war with its tendencies. Such speculations not being of a tangible nature, cannot be brought to any other test than that of pure reason; and since it is the fate of great talents to be almost invariably accompanied with deep sensibilities, it occasionally happens that the strongest reason obeys the behests of some more predominating passion, in dethroning the true system and setting up a more convenient, but a false system in its place. The absence of close compact inference is easily supplied by ingenious sophisms and brilliant rhetoric; feeling and interest is listed on the side of argument, and with the majority conviction is the result. When the tenets established by such a method became fostered in subsequent ages by the associations of infancy and kindred, it is no marvel they should thrive and flourish so as to perpetuate, among the generations of vast communities, the opinions to which they gave rise. It is to such influences, combined with the action of the imaginative feelings, which these subjects very largely call into operation, that conflicting views on the more purely spiritual sciences are to be traced. It is simply because this class of the abstract sciences can only be built up by pure reason, that the generality of men who allow prejudice and imagination to interfere with the inferential process in them, are least able to decide between the rival claimants of orthodoxy. Could we, indeed, shut out human volition and the action of disturbing fancies, mankind would no more differ about the conclusions to be drawn from the primary elements of theology and ethics than with the de-

ductions from geometrical postulates and definitions. Were prejudice and feeling, on the other hand, let in upon the mathematical branch of these sciences,—were it any one's interest to impugn some of the derivative principles of the calculus of variations, or did the overthrow of any propositions of the higher geometry strongly administer to any party's gratifications, the world would not be long without a new system of conic sections and a fresh doctrine of limits.

Yet we are not to relinquish, on account of these disturbing influences and great obstacles, the erection of an imposing group of moral sciences, on grounds quite as solid as those which refer to the material world. Notwithstanding the sociological portion may not give us the same power to predict occurrences without a cloud of conditions, they will help us to many generalisations of practical importance and theoretic value, affording a guide to the statesman in the control of communities, and throwing light, in the eyes of the philosopher, on the ultimate laws of human nature. Upon such generalisations, provided they arise from a wide induction of historical phenomena, and enable us to account deductively for any past occurrences to which they are capable of being applied, no cavil or doubt can arise. They can be brought to the touchstone of fact, and men cannot call in question what they see: while with regard to those subjects which admit of no such verification, but simply concern complex inferences from *à priori* data, we must rely on the variety of proof that correct reason is capable of receiving, and the inconsistencies which are the never failing attendants of erroneous inference, for securing their derivative principles from error.

§ 2.—*The Sciences amenable to the Abstract Deductive Method. The Functions of the Cross-examining Elenches and the Negative Process. Examples of Scientific Praxis.*

The moral sciences may be divided into two large groups —viz., those which consist of inferences drawn from *à priori* resources, and others which in conjunction with many branches of such inferences are raised out of generalisations drawn from an extensive examination of the past. The last group refers to coincidences between the order of succession, or to the laws by which one state of phenomena generate another,

and is co-extensive with the sociological branch; while the first comprises the conclusions our reason obliges us to infer from general principles, either co-existing within, or delivered to us from external authority; in which case, the sphere of inference will extend over the ground from which we are led to infer the existence of such indubitable authority, and the fact that the revelations we receive come entirely from its hands. The proof, however, is *à priori* and deductive even throughout those links of it which deal with sequence between a certain order of facts; depending not on the causal tie between the facts themselves, but solely on the relation which these bear, or the point of view in which they may be considered, to the external authority, or to the co-existing principles, whether natural or revealed, which are said to have emanated from it. Now, such relation being decided by the rational principles of the intellect, the proof at this stage of the process is no less abstractedly deductive than when the legitimacy of the general propositions having been made out, we are only concerning ourselves with drawing inferences from them.

The sciences which compose this group are evidently theology, ethics, legislation, and that portion of psychology whose laws may be completely learned by a study of the co-existing laws of the mental constitution without reference to the dependence of one state of mind on another, or the connexion between antecedent states and the present, which, of course, involve generalisations from experience. The elementary principles of each of these subjects may be regarded as so many definitions, axioms, and postulates, from which the complete body of their respective truths are evolved by a process exactly identical with the geometrical method. For example, the primary data of ethics and legislation are certain irreversible and irrepressible convictions stamped on every breast, by which each human creature is urged to fulfil the destiny of his being, and preserve his faculties, appetites, and feelings which make up his individual constitution, in that healthy state of action and subordination which will most conduce to his own happiness and the welfare of others. Such convictions as admonish us to do injury to no man, to preserve our veracity, to submit our passions to the control of reason, and in general to abstain from actions which awake censure or shame, all which principles are co-existent

with human nature, and compose the spiritual instincts which enter into its constitution. They comprise, in one word, the natural code by which, in compliance with the mandate of the Apostle, every man is bound to govern himself[1]. Some persons, indeed, may be found to deny the existence of such principles *à priori*, and resolve them into the mere creatures of conventionalism; just as there are persons who will deny the existence of matter, or the commonest axioms of physical science; but the generality of men in every position of life—savage, civilised, or semi-barbarous—bear witness to the indigenous character of their origin. Now, it is in the application of these common principles to adjust the actions of man with relation to himself, his Creator, and his species, that ethics consists: so far as the violation of such principles, either in their ultimate or derivative form, interferes with the welfare of society, it is the business of legislation to take cognisance of their influence. But the process in either case is identical with the geometrical method. When we examine any particular question that may arise with a view to establish a new derivative proposition, we simply survey the relations which the case bears to the main principles and the subordinate ones already deduced from them, and cast up the result. Should a new theorem be demonstrated, the links of inference by which the previous propositions led to its establishment are brought into systematic connexion, and the new law takes its place in the series of constructed truths, and performs its functions in the generation of others.

Thus, were it required to solve the ethical problem whether any action is formally indifferent, it would be necessary to examine first in what good or evil consists, and then consider if there are any human actions which do not enter into either category[2]. But the first case is determined by the theorem previously established, that an act is good or bad according as it accords or conflicts with the natural law; the sole point, then, for investigation is, whether any act can be realised without doing either. Now, as a preliminary step to the decision, we ought to distinguish everything which a

[1] "For when the Gentiles which have not the law, do by nature the things contained in the law, these, having not the law, are a law to themselves." Romans ii. 14. [2] Summa Theologia of St. Thomas Aquinas, pars. ii. sect. 1st, 2nd, and 3rd.

human act includes that we may know in how many ways an act is capable of being viewed in connexion with the natural law: first, there is the material thing done with its attendant circumstances; secondly, the motive which incited the action. As to the material object, it is evident many acts do not come within the cognisance of the natural law. If we walk, or play an instrument, abstracting from the purposes which urge us to do these things, no good or evil can attach to the naked act itself: but if either be executed with a good or bad purport, the law is directly applicable, and will pronounce its sentence. The question, then, is narrowed to the simple case, whether any motive can be indifferent, which is easily determined in the negative by the consideration that man is bound to direct all his actions in harmony with the fixed constitution of things, and to do nothing through levity or without a rational motive. A conclusion, indeed, which is doubly corroborated by the Christian law, which exacts an account of every idle word and action[1], and requires its followers to consecrate the intention of all their actions to the glory of the Supreme Being.

The establishment, however, of such propositions do not end with direct proof: before they can be accepted as indubitable truths, it is necessary not only to demonstrate their certainty, but to show that every other mode of looking at the question is illusory. This, which is called the negative process, performs the same functions in moral evidence as mathematics do in the physical sciences, at least as far as verification is concerned, placing the demonstration beyond the shadow of doubt by the decided manner in which every objection is met, and by investing the proposition with double proof, viz., the direct, and the *reductio per impossibile,* which is so powerful in elementary geometry. Thus the proof of the intrinsic moral nature of man's actions, arising out of the natural law, is not only based on each one's individual consciousness, and the universal consent of mankind; but it also rests on the fact that no other principle can be assigned which will account for it. For if such exist, it must be either the utility of society, or the free election of Providence, or the manichean principle of two antagonistic deities. The last supposition, implying a contradiction, is philosophically absurd; the second is contrary to the attri-

[1] St. Matthew, xii. 26.

butes of God; and the third is inadequate to explain the keen perception of right and wrong which is found among isolated savages, bound to each other by no links in the way of treaties and compacts. Hence all other possible cases being put out of court, the understanding bounds back to the direct proof with a confidence equal to that with which it embraces the strongest demonstration of physical science.

Ethics are connected with theology, natural and revealed, by the principle which insists upon the worship of the Deity—a law that is as irrepressible and fundamental as any in its category. Natural theology, however, to silence the cavils of atheists, proves the existence of the Supreme Being by the *à priori* argument that mechanism cannot exist without an artificer, and that the evidence of design is on so stupendous a scale in the universe as to require a Being of the grandest capacity to project it. The demonstration of His infinite attributes follows from the necessity of His existence as the fountain of being; and consists of many diverging lines of argument, each strengthening one another and meeting in the same point. The negative process is also employed to prove there is no assumption which accounts for the existence of the universe apart from the Creator, without landing its maintainers in startling contradictions. Thus every step in this link of the proof is purely deductive, certain common principles being laid down, which we are compelled by the intellectual laws of our nature to accept as the conditions of the world's existence, from which are reasoned out successively the existence of the Deity and all the qualities with which His nature is endued. The other branch of proof by which His revealed will is established is similarly deductive; it being assumed to be impossible that rational men could bear witness to certain truths and miracles which they knew to be impositions, or of which they were only half certain, with no other prospect of reward for their pains than punishment and death. This assumption rises out of the constitution of human nature. The case which it involves is sufficiently evident from history. There are, moreover, multiplied lines of inference corroborating the same point, all of a strictly *à priori* kind: such as, the existence of God being proved, the strong antecedent probability in favour of revelation, and the consonance of the doctrines taught with the natural attributes of Deity. As soon as the fundamental tenets appertaining to revealed dogma are thus esta-

blished, the process of inference from them is quite of a similar character with the ethical deductions already described, and is amenable to the same verifications. With respect to the moral branch of them, or Christian ethics, this confirmation partakes of a duplicate character. For the moral doctrines of Christ are in unison with the natural law, and no inference from His teaching can be accepted which conflicts with any portion of that law either in its ultimate or in its derivative principles; and every inference which cannot be shown to have a strict connexion with it, must be received with doubt, until resolved, like a complex law, into the higher principles of natural ethics, and shown to be a particular exemplification of them.

Of the former kind of argument an example may be adduced from Paley. His thesis that the Christian religion came from God, is made to rest with respect to historic evidence on the premises that "a religion attested by miracles is from God," and that the "Christian religion is so attested[1]." The minor proposition, about which only men are to cavil, is proved by a syllogism in Barbara:—"All miracles attested by such witnesses as we have named are worthy of credit. The Christian miracles are attested by such witnesses; they are therefore worthy of credit." The minor premiss of the latter syllogism is then divided into the several propositions of which it consists, each of which is established separately. In the first place, it is proved that the witnesses had no prospect but suffering from the nature of the case, because they were preachers of a religion unexpected and unwelcome to the Jews and the Gentiles. That they actually suffered, is proved from the testimony of the Jewish, Heathen, and Christian writers; and that they voluntarily exposed themselves to suffering, rests on the authority of the same writers. In the second place, it is proved that what they suffered for, was a miraculous story; by the nature of the case, as they could have had nothing but miracles on which to rest the claims of the new religion; by the allusions to miracles,

[1] It is remarked by Dr. Whately that the minor of this syllogism was admitted, while the major was denied, by the Pagans; but as the case at present is reversed, Paley's argument goes to establish the minor premiss, about which alone in these days there is likely to be any question. Logic, Appendix, iii.

particularly to the Resurrection, both in Christian and profane writers, as the evidence on which the Christian religion rested. It is also shown by the same evidence that the miracles in attestation of which they suffered, were such as they professed to have witnessed. In the third place, it is proved that the miracles thus attested, are what we call the Christian miracles, by the nature of the case that it is improbable that a new fiction should have replaced the original story; by the incidental allusions of ancient writers, both Christian and profane, to accounts agreeing with those of the inspired writings; by the credibility of the Scriptures, established by several distinct arguments, each separately tending to show that these books were, from the earliest ages of Christianity, well known and carefully preserved among Christians. Again, it is proved by similar premises, that the early Christians not only submitted to new rules of conduct, but that they did so in consequence of their belief in miracles wrought before them.

The major premiss, that miracles thus attested are worthy of credit, Paley next proceeds to establish; first, by the improbability that men who could have avoided all their sufferings had they lived quietly, should have provoked the knife of the executioner, by pretending to have seen what they never saw; that they should go about lying, to teach virtue, and persist, with a full knowledge of Christ's imposture, in propagating the frauds, which met with such reprisals as the crucifixion, and shed their blood in attestation of their reality: secondly, by the fact that no false story ever has been so attested; which is shown by adducing the several stories that can be produced as parallels to the Christian, and proving either that they are not so attested, or that they are not properly miraculous. Hence the minor of the leading syllogism is fully made out, and granting the major, which has been fully conceded since the pretensions of magic have been exploded, viz., that a religion attested by miracles is from God; the conclusion inevitably follows that the Christian religion came from God.

To avoid unnecessary prolixity in the analysis of this argument, we have left the obvious premiss in most of the syllogisms unexpressed, it not being needful in the analysis of any train of reasoning to express the implied premiss. When wanted to reduce the syllogism to its strictly technical form,

with a view to detect a lurking fallacy, the implied premiss is promptly suggested by the leading premiss and conclusion. In following out a process of this kind it is necessary to begin with the last point established, and, tracing the reasoning backwards, to examine on what grounds the inference is made. The assertion will be the conclusion, the grounds on which it rests, the premises. The premises must then be taken separately, and the grounds on which they rest examined, according to the plan we observed with the first conclusion. A premiss must have been used as such, either because it required no proof, or because it had been proved. In the former case it must either be self-evident, or universally admitted, or conceded by the opponents of the argument. In the latter it must be regarded as a new conclusion, derived from other assertions which are premises to it, which are to be examined in turn, and if found correct, treated as other conclusions derived from other assertions. If the train of reasoning be correct, the analysis will continue till the premises with which the whole commences are reached, which, of course, should consist of assertions requiring no proof; but if the chain be anywhere faulty some proposition will arise in the course of it, either assumed as self-evident or incorrectly deduced from other assertions[1].

[1] The substance of the directions in the text are taken from the preface to Hind's Introduction to Logic. Dr. Whately exhibits the logical analysis of a course of argument in the form of logical division. Thus:

[Ultimate conclusion.]
Z is *X*
proved by

- *Y* is *X* proved by
  - the argument that
    - *B* is *X* &c.
    - *Y* is *B* &c.
  - and by the argument that
    - *C* is *X* &c.
    - *Y* is *C* &c.
- *Z* is *Y* proved by
  - *A* is *Y* [suppose admitted.]
  - *Z* is *A* proved by, &c.

The branch of psychological science which falls under the head of the abstract deductive method, is the study of the structure of the intellectual constitution, with a view to ascertain the laws through which the different faculties manifest their statical agency, so far as the reasoning process is concerned, and the estimation of evidence in all its branches. These laws have been pretty extensively developed, in the *Organon* of Aristotle, and the *Kritik* of Kant, who may be taken as fair exponents, of the methods by which their highest generalisations have been reached, and the modes by which they are to be extended. No reflection upon experience, or analysis of scientific proof, enabled the Stagyrite to see the syllogism in the human mind, and point out the nineteen different ways in which men may naturally reason. He showed, from the necessity of the case, that every conclusion required two premises; that the three propositions concerned were only capable of a limited number of legitimate combinations; that such combinations involved distinct qualities in the propositions themselves, which arose out of the relation of the subject with the predicate; and that the nature of the subject and the predicate implied the logical properties of terms. The mode by which Aristotle constructed in a few weeks the system which has employed, and is destined to employ, men's thoughts for decades of centuries, was precisely identical to the method by which the early mathematicians ran up the splendid series of proofs which constitutes the lower geometry. Descartes in a similar manner established his methods, and Kant connected the derivative laws of the old philosophy and the new, with the ultimate principles of the intellect. No attempt has been made to expound the laws of the imaginative faculty, by seizing one or two of its elementary principles, and making them the parent source of the rest. Yet there is the same mutual dependence between their functions as exist between those of the reasoning faculty, and they only lack some genius rivalling Aristotle in systematic and ratiocinative power to yield up similar results.

§ 3.—*The Laws which regulate successive states of Mind. The Sociological Sciences. The Concrete Deductive Method, direct and inverse.*

The remaining group of moral sciences concern the laws of sequence between phenomena, whether individual or social. In the former they regard the laws which generate particular mental states, either with regard to the entire mind, or only with reference to some of its dependencies. For instance, the law of association of ideas unfolds the series of relations existing between different classes of thoughts and feelings, which make one suggestive of another: as such, this law is only one of the hundred operating agencies by which the mind is constantly modified and gradually urged from one state into another. Each of these single agencies work according to constant laws, though their force varies in different persons. Thus it is a law of memory, that a page is sooner committed by learning it by section, alternately closing the book and looking at the passage only to catch the escaped word, than to attempt to grasp the whole at once by keeping the eye continuously on the sheet; yet the precise force with which the law operates is never found exactly the same in two persons. The affections, appetites, feelings, and passions have each also distinct principles of action as well as the intellect, and though capable of being modified by many circumstances, manifest invariably certain tendencies, which are capable of being singly calculated within certain limits of error. Now, besides the laws peculiar to themselves, each of these phenomena have some properties in common. For instance, it is a law that the force by which each of these powers act increases in quick progression the power of its action, so that if any one be indulged to the exclusion of the others, that one is sure to predominate over the mind. It is the study of these agents, both singly, and in unison with each other; their peculiar together with their common properties; the uses for which nature designed them, and their effects both in ourselves and others, that constitutes the science of human nature in its largest extent; a study however which, apart from writers of fiction, seems not to have engrossed any portion of the attention of mankind. We have no treatises on the passions or affections, yet the special

treatment of each of these in the various points of view we have marked out, is indispensable to a complete system of education, and an accurate knowledge of the development of society.

It is obvious, from the complex nature of the phenomena, that we have no other mode of tracing the effects of the agents we have considered, in any given case, than by following out their laws singly, by comparing their relative strength, by taking into consideration the circumstances concerned, and forecasting the result deductively. It is precisely a case of the composition of causes considered in the last chapter, where the result, comprising a crowd of clashing and strengthening forces, baffles every attempt to unravel the knot of effects and to assign to each its separate cause,—some of which are entirely neutralised in the action, and others blended into one result. The only obstacle to so complete a prediction of the result as would attend a similar investigation in mechanical philosophy, is the uncertainty generated by the action of the will, and the impossibility of estimating all the influences which may direct its action in any given case. Nor can we expect the progress of the science of human nature will ever place us in so favourable a condition. All our data, consequently, must express tendencies, not certain effects; and notwithstanding the inferences built upon them will not warrant unconditional prediction in any case, they will be of eminent importance as a guide to the knowledge both of any person's conduct, under certain circumstances, and of the special training required to produce certain habits of character. In some instances, erroneous or incomplete data may lead us into wrong conclusions, but these are not to be set down to the subject's unfitness to be invested with scientific formula, but simply to wrong calculations. We may rely upon the fact that causes are at work in instances which appear the most complex and casual, and though compounding their results, acting according to invariable law, whose effects, were we in possession of all the data, are capable of being computed *à priori*, even throughout their most intricate combinations.

Nor are the moral sciences alone in this uncertain predicament. There are elements in meteorology, in the motions of fluid masses, and the laws of the tides, which must always

remain unfathomable, and for which allowance must consequently be made in the calculations which compute their effects in any given instance. We know, for example, the great operating causes at work in the production of the tides, and are able, under certain conditions, to compute their general effects, even in unknown quarters of the globe; but if precise accuracy be required, the calculation will be of no avail in any single instance. For there are causes of a local or casual nature, such as the configuration of the bottom of the ocean, the indentations of shores, the direction and strength of the wind, which it is impossible to foresee, and which are always sure to interpose, and in some single cases may altogether conspire to defeat the result. In meteorology, again, the chief proximate operating causes, and the laws which regulate their influences, are so unknown that it is impossible to predict the order of antecedence and consequence between its phenomena with more than a very moderate degree of probability. Yet no one doubts that tidology is a science, and that meteorology is destined to become one; or, in other words, that all the phenomena which these sciences embrace are not generated by special causes, which act throughout all their combinations in accordance with invariable laws, and that the general action of such causes is sufficiently cognisable to the human intellect to admit of being predicted within limits of time and space wide enough to leave a broad margin for the realisation of purposes of practical utility. Nothing further is claimed for the science of human nature, and, indeed, hardly anything further is required. If we are able to foretel from a general examination of any individual character what will be his conduct in any given emergency, or what course of discipline will generate certain states of mind, or what principles of action, in the generality of instances, are at work in the production of the varieties of habits, tempers, and characters, we need no further theoretical knowledge to produce results of the greatest practicable importance to our species.

It is not through any belief that such knowledge is unattainable that the present backwardness of this science is owing, but chiefly to the unscientific methods by which men have sought to obtain it. They have generalised from the smallest empirical data, and rushed into the highest regions

of art before drawing out, or having any definite conception of, the propriety of the theory which the art involved. Having stumbled upon the agreement of certain states of mind with a certain anterior routine of practice, they inquire no further, but chain themselves down to the system which embodies the result. This crude generalisation of passive experience is at the bottom of all our systems of civil, of military, and ecclesiastical education, and constitutes the prescient wisdom of those who are said to be observant of character and profoundly read in the world. Without any idea of the action of the individual laws at work, or correct insight into the complex agencies which concur to the production of the effect they have the temerity to predict, they consult the note-book of their former experience, and decide according to the superficial aspects of the case. This, to draw an illustration from a science whose methods are in every respect analogical, is precisely as if a man, without any knowledge of the internal structure of the human body, were to construct a system of therapeutics, or to predict simply from his past experience the effects of a certain medicine on any constitution of body. If it is a universal complaint, that the treatment of many disorders in the system is founded on mere empiricism, the censure is doubly applicable to the efforts commonly made to regenerate human nature.

One of the first steps required to construct this science on its true foundation is the production of separate treatises on the different groups of homogeneous phenomena which enter into it, as respects the action of their particular laws taken singly, and in conjunction with others. Something of this kind Bacon intended for the intellectual faculties in the little tract he wrote for Sir Henry Saville, the provost of Eton; but the treatise was limited solely to the improvement they are capable of receiving by due attention to psychology in a course of preliminary education, an attempt which Dugald Stewart further followed out in his Philosophy of the Human Mind. The latter work, however, notwithstanding the learning and the attainments of the author, from aiming at too much within its limited compass, accomplished little. Had the two volumes, in which the treatise is comprised, merely examined the operations of one or two special faculties, a step would have been made in the direction we point out. Upon the passions and feelings we have not even an attempt at

distinct treatises[1]. The early fathers and a modern class of theologians, in their disquisitions on practical morality, have marked out many derivative laws which this class of mental phenomena manifest, but entirely with a view to the acquirement of certain habits of virtue, and not to enlighten us on the general nature of their action, though this, to some degree, is their collateral effect. Of course, in connexion with the purely mental consideration of each of these special classes of subjects, the physical condition of the body ought to be studied, as there is no doubt of the influence of temperament in producing moral and emotional peculiarities, and also of the relation of certain cerebral conformations with specific intellectual qualities.

This branch of the process, which concerns the obtaining materials out of which to construct a science of human nature, is obviously one, to a great extent, of observation. The world, however, has existed long enough to give us facts in abundance if we will only take the trouble to look out for them; and every different position in which man has been placed, every phase of character he has assumed, is a storehouse from which the most valuable results may be drawn. The great fear, however, is, that in collating the experience afforded by various institutions and countries, antipathies or predilections in relation to one or other may interfere, and make correct inference on any given point impossible: but such prejudices must be cast aside, as we dismiss in natural philosophy illusions of sense, or prepossessions in favour of any ill-judged theory, being conscious that while such distortions remain we are incapable of moral science. Indeed, more caution is required in divesting ourselves of such preconceived notions in this division of the sciences than in physics. For observation, here, is almost solely at work in the preliminary process, with little or no help from artificial experiment, and relying to a great degree on the methods of agreement and concomitant variations: any perversion of fact, therefore, is less likely to be eliminated by more extended observation than where the five methods come into play; and if it concern the operation of any institution of magnitude, it will doubtless

[1] Smith's moral sentiments hardly comes under this class, its aim being to examine the feelings not so much with reference to the laws of their own nature as to a particular theory—viz., that of their empirical origin.

prevent our obtaining a correct notion of some important law of human nature on which such institution relies for its success, and so interfere with the process by which the specific law is resolved into the ultimate principles of psychology.

It is only after a careful examination of the laws of the homogeneous groups, both in their simple and conjunct action, that we can expect to reach that general knowledge of the order of antecedence and sequence in psychological phenomena which will enable us, from a few combinations, to rise to the general principles at work in the production of their complex states, and connect them by deductive inference with the *axiomata media*, from which they branch out into ramified connexion with particular facts. Now, since it is entirely in our power to modify such general principles by directing them to a given end, man, by the faculty which such knowledge would confer upon him, might become in some measure his own automaton. He need only calculate the human agencies at work in the production of a given character to superinduce that character either upon himself or others, that is, allowing that time permitted the operating causes to work out the result, and that his physical and mental constitution opposed no insuperable barrier to their action. Knowing from the general laws of mind what actual or possible combination of circumstances are capable of promoting or preventing the production of certain qualities, it is obvious he can not only predict the particular type of character which would follow any assumed set of circumstances, but generate any quality he wishes in others, if those circumstances should be in his power[1]. As the science, however, in its elementary stages is inductive, and as all its subsequent processes concern tangible facts, the deduction of specific qualities accruing from particular circumstances of position, must always be verified by the recognised results of actual experience. As in the physical concrete deductive sciences, whose method the science of human nature assumes, each *à priori* deduction must be compared with inductive inference from particulars. The theoretic conclusion as to the type of character which should be formed by any given set of

[1] One of the facts which such investigations are calculated to bring to light is, that men differ less in natural capacities than is commonly supposed, and that much is set down to genius which is only the result of artificial aids and methods.

circumstances, must be tested by the specific experience or those circumstances whenever obtainable; and the whole conclusions of the science must undergo constant verification and correction from the general observations of mankind[1].

The phenomena of society are produced by the operation of outward circumstances upon masses of human beings, but as the laws in operation among the single individuals, which compose the aggregate body, are those of human nature, it follows that the phenomena of society are produced by complex combinations of the principles which govern human thought, feeling, and action. Hence, the social states are quite as much the product of fixed laws as the individual states; the phenomena are only more complex, and the proximate principles more derivative, not, indeed, from the number of laws in operation, but from the extraordinary number and variety of the elements, or agents, which in obedience to that small number of laws co-operate in producing the effect. If the laws of human nature, when concerned with individual phenomena, required the deductive method to unravel the complexity of the results, the need for the application of the same method to social phenomena is doubly increased, when we consider that this group of subjects arises out of a multiplication of the complexity considered in the most intricate phenomena of individual character. If, indeed, in the latter subject crude empiricism was to be condemned, in sociology it is far more censurable; since the laws of human nature at this stage exist in far more complex states, and present more intricate problems for solution than are to be met with in individual character.

Up to this time, however, with few exceptions, the only attempts made to modify social states, or even to theorise upon the regeneration of society, have been of this character. Apart from all consideration as to the organisation of any particular state of society, men have advocated measures for their amelioration, influenced by no other motive than that the specifics recommended had been found good in other instances; forgetting that one remedy could not cure all diseases, and that what was salutary in one climate might

[1] Mr. Mill treats these laws as a distinct science, under the name of Ethology. In this and the other portions of his treatise he follows the doctrine of Comte, but with such allowance for the free action of the will as not to disturb the ashes either of St. Augustine or Pelagius.

prove poisonous in another. After a measure was deemed good in itself, the only question which these philosophic politicians asked themselves was, how can we get the people to adopt it? No social arrangement that might be deemed desirable was expected to encounter any obstacles from the organism of the society to which it was to be applied, but solely from the private interests or prejudices of the individuals who constituted its members. Statesmen thus attempted to master the pathology and therapeutics of the social system before they had laid the necessary foundations in its physiology—to remove distempers without understanding the laws of health; and the result was such as it must always be when men, even of conspicuous ability, attempt to deal with the complex questions of a science before its simpler and more elementary propositions have been established.

There is a close analogy between the organisation of different states of individual character and those of social communities. In the latter, as in the former, there are homogeneous groups of phenomena capable of being studied apart from the general subject, and forming in themselves the nucleus of distinct sciences. Such are political economy; the science which concerns the formation of political character, or the character belonging to each age and country; and the science of government. Each of these subjects takes into consideration a distinct class of phenomena mutually dependent upon one another, and not likely to be much interfered with by the action of the other agencies which enter into the organisation of society, at least beyond results which are capable of being calculated and allowed for in every instance. Thus political economy takes cognisance of such phenomena of the social state as are generated by the pursuit of wealth. It makes entire abstraction of every other human passion or motive, except those which may be regarded as antagonist to the desire of gain: viz., aversion to labour and desire of present enjoyment. Nor are its results, when the data are fairly expressed, ever wide of the truth. For, notwithstanding men in all cases are not influenced by the desire of obtaining wealth with the least possible labour, upon which supposition the fundamental axioms of the science proceed, it cannot be denied that in commercial speculations such assumptions hold; and since the principles of political economy are only

applied to transactions of this nature, provided they exactly express the laws of the tendencies to which they refer, they are never likely to mislead. Now it is only when the phenomena are so restricted to a definite class of subjects, that we are favourably situated for acquiring a knowledge of the minuter agencies which enter into the organism of the social state, and calculating (*à priori*) by direct deduction the effect of any single law. For in such cases, the circumstances with which the new law will interfere are previously known; and no counteracting or disturbing agent can lie concealed to mar the correctness of the calculation founded upon their absence. For instance, suppose the effect is required to be known of commuting a certain quantity of indirect for direct taxation: will the result be an augmentation of the wealth and productive labour of the community? Such a question is able to be answered by purely *à priori* considerations; for the phenomena with which the law has to deal are distinctly marked out by the nature of the case, and little inference is required to calculate how far the changes in question are likely to operate to the advantage of the community. The result of such direct reasoning can of course be easily verified by an appeal to actual experiment. In this manner Peel worked out those judicious alterations in the British tariff which have already made his name illustrious among European statesmen. It was commonly thought that during his first trials he was picking his way by the empirical process of observation, and thus making experiments on the nation as M. Majendie used to try his specifics on dogs and rabbits. But the fact was otherwise. Peel had convinced himself that such alterations were judicious, and the deliberate manner in which he worked them out, was simply to afford timely warning to the interests concerned, as well as to realise the sage counsel of Bacon, "in all your innovations imitate nature, whose changes are quiet and imperceptible," &c.

But it is obvious that the conclusion arrived at in this particular case could not be generalised and erected into a universal proposition of political economy. Had Peel been desirous to extend the same principle to any other European country, his object should have been to ascertain how far its financial condition was analogous to that of England, and to

what extent and in what direction the industry and habits of the people were likely to be influenced by the change. If the wealth of the nation was more equally distributed than in England,—were its merchants and principal speculators just struggling into importance, and its artisans in a flourishing condition, it is obvious that a commutation of a portion of the customs and excise for a direct tax upon capital would be attended with ruinous effects. It would be a blow against the rising civilisation of the community calculated to strike down those who manifested any aptitude to direct or manage its resources, and prevent them from grasping those facilities which might enable them to economise labour, to open new commercial channels to the enterprise of their countrymen, and found institutions of education and benevolence. Hence the results of such speculations are necessarily hypothetical. No branch of the sociological sciences will help us to a universal proposition, stating in every case the effect of any given law, but simply enables us to adapt the law to suit the circumstances of any given case. The separate study of the structure of the homogeneous parts of the social organism makes the statesman acquainted with all the phenomena with which the contemplated law is likely to interfere, just as the knowledge of any particular organ of the human system enables the physician to state *à priori* what agencies are destined to be neutralised, counteracted, or promoted by the action of certain diets and medicine; and it is the province of the medical or political operator to frame a law whose action on that particular function of the system is destined to eliminate the unsound tendencies and promote the healthy action of the vigorous parts. The several branches of the sociological sciences will furnish him with a multitude of generalisations for this purpose true under the circumstances in which they were obtained. It depends on his own tact, how far he may be enabled to bring the new case contemplated, under any one of these heads, in order that the same specific may be applied with as little alteration of the text of the law as the circumstances warrant: but it is obviously the duty of every statesman, before he applies his law, however cautiously its provisions may have been framed, to meet the peculiar circumstances of the case, to examine if the kindred sociological science will supply him with any instances of

the effects of similar laws on analogical phenomena, and so verify his conclusions by actual experience. If such precedents, however, cannot be found, if either the law, or the circumstances to which it was applied, manifest any startling discrepancies of character, or if he has reason to think that, notwithstanding the generalisation is similar which form the peculiarities of the case, many of the operating conditions lie concealed, the only possible mode of verification open to the statesman is to deduce from the principles involved in his law as much of the phenomena to which it refers both in past ages and different communities, as would be likely to be affected by it, and show that the results of past experience completely harmonises with the conclusions of his theory. If his expectations of the effects of any given cause in an assumed set of circumstances will not enable the statesman to explain and account for all that portion of the social phenomena existing in times past or present which that cause would have a tendency to influence, it is a proof either that the facts which ought to be taken into account are not known, or that the theory is not sufficiently accurate to meet all the consequences. In either case a statesman would do well to reconstruct his theory, and not venture to predict the future by inference from any data that could not be brought in unison with the present and the past.

The inquiries which concern these special branches of social phenomena generally concern the effects which will follow from single causes in a certain condition of social circumstances; but there is also a second inquiry with relation to the laws which preside over the general circumstances themselves, and determine the order of sequence and antecedence between one social state and another. It is found, for example, when the history of past ages is consulted, among the various states of society existing in the different regions of the earth, that certain uniformities exist between successions of phenomena; so that one feature of society never assumes a particular state without affecting the co-existing states in a more or less precisely determinate manner. For example: among highly civilised communities the existence of an extremely despotic monarchy is invariably attended with laxity of moral ties, and, if perpetuated for a long period, causes a decline of the arts, degradation of literature, and a

general retrogression of humanity. And, in like manner, where insuperable barriers are erected between the classes of any community, and the highest social functions are only open to certain privileged castes, mankind are never sure to emerge from a semi-barbarous state, or to make any advance in civilisation. Such uniformities between certain states of society and institutions are mere derivative laws from the higher principles of human nature, and can readily be accounted for *à priori*. For, if it be an axiom, as it assuredly is, that the phenomena of society are mere creatures of mind, and that the arrangements which they manifest, are more or less in accordance with the fitness of things according to the degree in which the mental agent manifests its supremacy; it follows that every society will flourish or decay in proportion as obstacles or inducements are flung in the way of its influence, or according to the mode in which the institutions of the country act upon its growth, or stimulate or depress its development. Now, the existence of castes, or slavery to any large extent, or an *imprimateur* clapped on the press, or the gagging of public opinion has this direct tendency; and such exclusions and prohibitions cannot be perpetuated through generations without engendering corruption of manners, and turning society itself into an instrument for the degradation of humanity.

The prosecution of sociology, nevertheless, in its present stage, labours under great disadvantages, on account of the backward state of psychological science, into which its laws are destined to be ultimately resolved. While the principles of psychology fluctuate, no derivative uniformity observable between co-existing or successive states of social phenomena can be verified by its connexion with the corresponding psychological laws; and the only mode of ascertaining the correctness of generalisations obtained by an analytical survey of history, is to resolve them into the simpler laws to which they inferentially lead, and to test their correctness at this stage by comparing the results to which they conduct, both in social and psychological phenomena, with specific experience. Thus, in the cases already cited, of the obnoxious character of those institutions which tend to depress intellect, the principle into which the uniform phenomena were resolved obtains, not only in individual instances, but in every single exertion of the human faculties. For those men are

the foremost of our species, in whom mind has most largely predominated, and who have opposed the least obstacle to its influence; and every reflex act of thought directed to resolve any problem, is more likely to obtain its purpose in proportion to the continuity and vigour with which it is exercised, or according to the abstracting power by which it shuts out extraneous influence and fastens on its object:—a truth, of which Newton acknowledged the force when, on being asked by what means he succeeded in revealing that wonderful law which unlocked the mechanism of the heavens, he replied, by always thinking about it. When principles are reached of this extensive kind, which account deductively for all the social phenomena in which they can be supposed to possess any large influence, if they may not be assumed to be the ultimate psychological laws wanting in the case, at least they may fairly be relied on as corollaries from them, and so far allowed to form the standard of indirect verification.

The empirical uniformities which it is the object of observation to set apart, as most likely to lead to the discovery of sociological laws, relate either to co-existent or successive phenomena; and according as this science is occupied in ascertaining and verifying the former sort of uniformities, or the latter, M. Comte gives it the title of social statics, or of social dynamics, conformably to the distinction in mechanics between the conditions of equilibrium and those of movement; or in biology, between the laws of organisation and those of life[1]. The first branch of the science ascertains the conditions of stability in the social union—the nature of the relation existing between the different parts of the social organism in its healthiest state; the second concerns the laws of progress, or the theory of society in a state of continuous movement. It must, however, be observed, that the study of social statics can never be so completely disentangled from the second branch as not to be in a great degree modified and controlled by its laws, as the uniformities of coexistence obtaining between social phenomena are mere corollaries from the laws of causation by which the successive states of those phenomena are determined. The mutual actions and reactions of cotemporaneous social states are

[1] Cours de Philosophie Positive, iv. 325.

mere complex effects arising from the fundamental movement going on among them. The mutual correlation, therefore, between the different elements of each state of society is a derivative law resulting from the laws of succession between one state of society and another; and if we make a provisional abstraction for the purpose of marking the coincidences between their simultaneous effects, it is not only with a view to ascertain the elements of social stability and many uniformities of practical importance, but also to approach closer to the resolution of the fundamental problem of sociology, and discover the laws according to which any state of society produces the state which succeeds it and takes its place.

Of the practical value of this division of the science there cannot be a doubt to him who considers the flood of light capable of being shed upon the laws of social phenomena by regarding them in the two special states of mutual dependence and correlation, and making the uniformities of co-existence and succession act as verificatory tests of each other. It is, moreover, through the study of the uniformities of co-existence that we are led to observe the more recondite laws which preside over the generation of successive states of society, of which the derivative laws of correlation are mere complex exemplifications; and to form those general maxims, of the widest possible utility in statesmanship, which embody the elements of social union, the principles which constitute the ligaments by which the different parts of the social organism is bound together, the ingredients which enter into those ligaments and tend to increase or corrode their vigour, and the chief properties on which the healthy action of the leading functions depend, both in their individual states and conjunct agency. By this branch of sociology we are able to determine, from the absence or the presence of certain elements in any given society, the general features which characterised its past condition, just as we may infer from the state of the abstract sciences in any age the amount of erudition possessed by its leading sages[1].

In examining the elements of social stability the statesman will not only regard the essential requisites whose

[1] A case in point is furnished in the dissipation of the pretended astronomical lore ascribed to the Egyptian priests, as soon as it was known that abstract geometry did not exist among them.

presence is indispensable to the perpetuity of its functions, but the precise effect which has attended the relative degree in which they have exerted their action. He cannot fail to observe, for example, the effects of severe restraining discipline in fashioning the heroic states of antiquity, and the martial spirit infused into their population, both by the cultivation of a strong feeling of nationality, and by throwing open the highest posts of command to the ambition of the meanest soldier. He will not fail to observe the effect of an equitable administration of justice in teaching men to respect law; and the diminution of national wealth in proportion as property became insecure and as excessive commercial restrictions were adhered to. Nor can it escape his attention that without some form of religion no society can hold together long, and that the degree of its influence may be taken as a fair index of the soundness and durability of the concomitant parts. The indispensable conditions for the foundations of the social fabric may, indeed, be deduced *à priori* from the laws of human nature; but the precise degree in which they ought to be combined, to bring about a certain result, must be gleaned from a close examination of social phenomena, and the knowledge so obtained afterwards verified by comparison with psychological laws, and the known results of analogical combinations. By the pursuit of such methods men have erected social fabrics in times of great anarchy, founded empires on the ruins of old societies, and made the mean capital of a petty state the meridian of the earth's glory. Witness Charlemagne, Frederic the Great, and Napoleon.

The great object of social dynamics is to trace each of the principal features of every generation to its causes in the generation immediately preceding it. This may appear, where single states are concerned, to present little difficulty; for every element in each nation can have its causes distinctly marked out among the aggregate conditions that constituted the state of society in the preceding centuries. But such special cases only compose the materials of the elements which determine the leading qualities attaching in common to vast groups of progressive communities, which it is the aim of social dynamics to resolve in their complex causes, in showing what group of antecedents have generated each

of the general phases which constitute the character of any one generation. The difficulty of establishing this filiation, and mounting to the most general laws of the succession of social states, is increased in proportion to the number of distinct nations, and to the discrepancies of government, which they involve; for, according as men are kept under the action of various, and often clashing agencies, the uniformities of succession, as well as of co-existence, become more fragmentary, and present insuperable obstacles to the science which seeks to evolve them out of general laws. Nevertheless, this difficulty is not without its advantage, in affording a more ample field for the verification of the middle axioms of the science; since the assumed general uniformity may fairly be regarded as a derivative law of human nature, if it accounts for all the phenomena which falls under its influence in so diversified a theatre.

As it is only through the intermediate uniformities that we can hope to grasp the higher generalisations of the science, the means of testing their correctness cannot be too highly valued. Now this is afforded to us through the variegated social phenomena which constitute the living society of every age, and the different degrees of prosperity and decline they manifest in the various stages of their existence. If any uniformities of succession will enable us to explain why some nations continue to remain as they have begun, and scarcely seem to ebb and flow, while others have spent their vigour at the commencement, and others blazed out in glory a little before their extinction; why the meridian of some have been the most splendid, and others have fluctuated, and experienced at different periods of their existence different reverses of fortune; it is evident that such uniformities, found available for scientific explanation in so many contrary instances, may be relied upon as derivative laws, even if they only make out the case so far as their influence in the generation of the phenomena could be expected to extend. Axioms of this nature, which can be brought to the test of diversified experience, must form the first stepping-stones to higher laws; and if they can be deduced from the ultimate principles of human nature, these higher generalisations which it is the object of sociology to reach, will be brought within the limits of judicious conjecture, and the

suggestion started easily verified by comparison, either with the *à priori* law, or with the simpler uniformities already revealed.

The laws of social dynamics have been hitherto sought by two distinct paths, the consilience of which on any one point, has been deemed to furnish a strong verification of the generality of the resulting uniformity. The progressive tendencies of society have been pursued both in individual communities and large groups of nations, whose social elements bore in any respects a kindred character. The conclusion, in M. Comte's view, broadly announces the law that the course of progressive states of society, as well as that of separate nations and individuals, is marked by three distinct phases: the theological, which presides over the elementary stage; the metaphysical, which is the distinguishing characteristic of the middle; and the sceptical, or positive philosophic feature, which is the predominant element in the third. This generalisation, however, notwithstanding some striking coincidences, is not reconcileable with fact; nor is one of so sweeping a nature likely to be gained while the elementary laws of the science, which must form the platform to such a principle, are not yet raised from the ground. Similar empirical axioms have been gathered from an analytical survey of social phenomena, of a less pretentious character, and more within the limits of truth, but still open to occasional exceptions, and of course unverified by psychological laws; such as the aphorism of Bacon, that in the beginning of states arms flourish, while intellectual qualities are predominant in their maturity, and mechanical agencies characterise their decline; and those of some French historians, which imply that as society advances mental qualifications gradually assume control over animal force, and masses prevail over individuals; that the first occupation of mankind is chiefly military, which becomes by degrees absorbed in productive pursuits, until the spirit of clanship is entirely transformed into an agent of the industrial arts. These generalisations, even if strictly true, only assume the appearance of so many sage conjectures, and can be held of no scientific value, until shown to arise out of psychological principles, and connected with the more complex uniformities to which they are akin. The error of speculation in

this branch of sociology appears to consist in grasping at vague generalities, which seem to coincide with fact, but leave us without knowledge to state why they do so.

Such generalisations, however useful they may prove in the subsequent stages of the science, can be of no avail before the science can hardly be said to have commenced. To attempt to inaugurate the study of an *à posteriori* science by the fashioning of such universal propositions, is like commencing to erect a building by the formation of pediments to which we have no reason to know that the edifice will correspond. The only mode by which any advance can be made in the construction of sociological science is by mounting from the simplest and most evident uniformities to those of a more universal and complex character, and seeking at every step to infer what laws of human nature are involved in their production. A successful inference will lead us to connect many generalisations before deemed empirical with the ultimate principles of psychology, and to interweave them in a web of confirmatory relation with the lowest uniformities of the science. Thus, stations will ultimately become opened in all quarters, and cross-lines interposed, so that no accurate generalisation can be drawn from history without having its higher laws assigned, and being fitted into its precise place in the system. This is the invariable method by which all sciences that relate to successive phenomena, which have reached a high degree of development, have been cultivated. Nor can we see anything in sociology to exempt it from its influence. Yet the science was no sooner propounded by Vico, and began to excite any degree of attention, than its cultivators entered into hot discussion upon the last question that the science even in the highest state of maturity could be expected to resolve—viz., whether there results from the progressive movements of society either a cycle or a trajectory course? Whether society revolves in an orbit, or moves in a straight line and so never returns to any of its former states?—a problem whose resolution has about the same relation to the discovery of social laws, as the disquisitions of Thales on the first element of all things, have to the Galilean physics[1].

[1] The work of Giambattista Vico, entitled, Principi di Scienza nuova d'Intorno alla Commune Natura delle Nazione, first saw the light at Naples in 1725. But the most eulogistic of his editors admit that he

§ 4.—*Probable Inference. Example and Analogy.*

The moral sciences have their department of probable evidence as well as the physical, and that to a far greater extent. Since, in addition to their subjects being less advanced and exposed to more uncertain, intricate, and fluctuating agencies, there are many branches of evidence in them where direct certainty is unattainable, and the most that can be gained is a high degree of probability. By far the greater portion of the inferences we draw with reference to ordinary life, from the government of a kingdom to the crossing of a street, is of this character. Did we wait for grounds of complete certainty before we moved in the performance of any action, we should ever stand still. Human society would be in a state of perpetual blockade. Our only resource in the generality of cases is to calculate probabilities, and act upon them. We perceive that a specific point cannot be definitely established, and examine all the probabilities capable of being adduced in its favour, and weigh the aggregate amount with those against it. In proportion to the exact degree in which one or the other preponderate, ought to be our acceptance or distrust of the proposition. When arguments tend to esta-

was quite incapable, on account of the narrow circle of his erudition, to construct theories reducing to the philosophical union of causal connexion the multifarious phenomena of history. Vico, as far as Greek and Latin antiquity went, was erudite enough, and his historical theorems and postulates receive plausible support from that side of humanity; but he knew little either of the Oriental world or of the Middle Ages; and hence his abstract generalisations met with complete discomfiture when applied to interpret the phenomena which these stages of humanity present. His theory of the course of nations, being exclusively modelled on the Roman world, is quite in conflict with the vast confederations of European civilisation; and he regards those instruments on which the generality of the seers of the present age rely for the indefinite amelioration of their species, as the principal agents in bringing about that decline in European commonwealths which, according to his system, is again to reduce mankind to a state of primitive barbarism. The press, in Vico's view, is an engine calculated to obscure and weaken the judgment by the spread of useless facts (Op. lat. i. p. 41); religious toleration, a mark of the entire want of sincerity in religious conviction (Scienza nuova, pp. 350, 424). The abandonment of the ancient languages as a means of transmitting thought, according to the same author, will lead to the destruction of taste and philosophical acuteness (Opusc. p. 16). We need say no more to show the reader that Vico can hardly be trusted as a telescope of the future.

blish the point they are intended to support with various degrees of probability, no bare summing up of the single results will give us an accurate idea of the strength of the cumulative evidence without taking into account the deflection of the converging lines of argument and the amount of probability the conclusion receives, not only from the number, but from the variety and opposite nature of the proofs. For example, if a certain conclusion be made out by three lines of argument, each establishing a probability in its favour, varying as $\frac{3}{4}$, $\frac{6}{7}$, and $\frac{9}{8}$; in adding up these fractional probabilities, it ought to be taken into account, to what degree the adduced reasons vary in their subject-matter; and if this be to any extent, an additional fraction should be annexed to the aggregate sum to represent the improbability arising from the inference that a proposition should be untrue which was supported by testimony of so discordant a nature. There are likewise cases in which some deduction must be made from the total result for a contrary reason. For example, if the testimony of three witnesses be taken who have been in collusion with each other, in casting up the individual probabilities in favour of each party's testimony an abatement must be made in consideration of the identity of interest existing between them.

The latter is an instance of joining probabilities by way of addition, the result of which is an aggregate probability greater than the individual instances of which it is composed. There is another mode by way of deduction, where the certainty diminishes with every new instance of probability implied in the proof; as when we adduce the testimony of one witness, that he has heard a thing asserted by another, who was not himself an original witness, but who obtained it from one who professed to have ocular evidence of the fact. The former chain of evidence was termed by Mr. Bentham a self-corroborative chain; the latter, a self-infirmative chain[1].

Both are applicable to the summation of that class of propositions, whether physical or moral, which approximate to the truth, but do not universally obtain in all cases; such as, Most pious men are grave; Most rulers are influenced by self-interest; The generality of aged persons are cautious.

[1] Rationale of Judicial Evidence, book v.

Now, it often happens when such proximate generalisations are connected with others in a given proportion, through a term which is common to both, that it is required to be known what probability will attach to the occurrence of the new term with either of the other terms. Thus, if two out of every three pious men are grave, and three out of every four studious men are grave, what probability is there that every pious and studious man will have the property of gravity? The answer will obviously be $\frac{11}{12}$. For the probability against the supposition will arise out of the compound of the single probabilities. Now, against the occurrence of the first there is the chance of $\frac{1}{3}$, and against the second $\frac{1}{4}$, the compound result of which ($\frac{1}{12}$) deduced from unity assigns the probability we have determined upon. Hence the aggregate probability is greater than the individual ones $\frac{2}{3}$ or $\frac{3}{4}$. Again, suppose that proximate generalisations similarly connected were required to be dealt with by way of deduction, the probability arising from two propositions taken together in this case will be correctly measured by the probability arising from one abated in the ratio of that arising from the other. Thus, if nine out of ten charitable persons are religious, and five out of every twenty inhabitants in London are charitable, the probability that any metropolitan citizen is religious will be $\frac{9}{40}$, or somewhat less than $\frac{1}{4}$. It is evident that there can be many links to such calculations, but each additional step only involves a repetition of the principle we have laid down.

Proximate truths of this kind may, however, occasionally be transformed into universal propositions of scientific accuracy, by assigning some mark which clearly separates the accordant from the exceptional cases; and reasonings dependent upon them may be carried to any length we please, by taking care, in the introduction and composition of every fresh generalisation, to annex the sign on which its universality depends. For instance, the proposition *Most* persons who have uncontrolled power employ it ill, may be invested with a universal character, either by assigning the features which invariably characterise licentious despots; viz., weakness of judgment and will, with depraved habits, or by assuming the opposite qualities to these as exceptional cases. Thus, *All* persons of weak judgment and depraved

habits who have uncontrolled power employ it ill; or, All persons who have uncontrolled power employ it ill, provided they are not persons of unusual strength of judgment and confirmed habits of virtue. Now, if we annex to this proposition another of a similar character, as, All absolute monarchs have uncontrolled power who are independent of the active support of their subjects, we may deduce from both the universal conclusion that all absolute monarchs employ their power ill who do not need the active support of their subjects, unless they are persons of unusual strength of judgment and confirmed habits of virtue. It is of no concern how rapidly such conditions accumulate, provided we assign the distinguishing rank to each proposition, and express the aggregate with every additional conclusion.

Occasionally, as in reasonings which concern large masses, and do not in the slightest degree affect the actions of isolated individuals, proximate generalisations are all that is required, even to establish a conclusion of scientific value. Neither the general or the statesman desires complete accuracy in the data on which they found their respective measures for the guidance of the numbers over whom they possess control. It is enough for them to know that most persons comport themselves in a particular way, since their speculations refer almost exclusively to cases in which vast groups of men are acted upon simultaneously, and in which, therefore, what is done or felt by most persons determines the result produced by or upon the general body. In these cases proximate truths assume the nature of precise generalisations with reference to the results to which they are intended to lead. The properties of multitudes can only be ascertained by approximations of this nature, but they are not the less strictly amenable on that account to scientific law than those of individuals.

The probable inferences in the moral sciences which correspond to those drawn in the physical, from the resemblance of their objects to phenomena whose properties for the most part lie beyond the grasp of our faculties, may be ranged under the head of example and analogy. We are not able to penetrate beyond the vista of the present, and form indubitable inferences with respect to the future effects of certain actions upon any specific individual; for, being ignorant of the

impulsive forces which generate individual character, and the laws according to which they act, we want all the data that could help us to a conclusion of scientific value; yet we augur the complexion of those effects, and in the generality of cases find we are not far short of the truth. These conclusions are found to predict in many cases with tolerable accuracy what will be the future position of a character chiefly dependent on fame, on knowledge, and talent, for success; and that with no further data on the part of their framers than what is afforded by superficial observation. They know what has occurred in past instances will occur again if similar conditions supervene, and they leap from the resemblance of properties to that of effects. This is strictly the argument of example. It is induction on practical matters, the laws of whose action are hidden from us, but whose uniformities we nevertheless predict, grounding our inference upon the effects which the laws have exhibited in the past. Of this kind of loose induction Horace will afford us an example: "If my father," says the poet, "wished to persuade me from squandering my estate in profligate living, he would point to some spendthrift who had ruined himself[1]." The father of the bard left him to infer from the example of Barrus, and the son of Albus, who had both impoverished themselves by luxurious living, that those who so act commonly come to ruin. The staple argument of most people assumes a similar form. They judge simply from past effects; and according to the constancy with which the uniformity in question has obtained, they imply its occurrence in future.

To such kind of inference there can be no objection, if not stretched further than the limits in which it has been observed warrant; but the evil is, that men leap from a few casual instances of successive or concomitant uniformity to a wide generalisation, implying a law of causation between the phenomena concerned. Having observed that the country prospered under unfair institutions, or that trade flourished

[1] "Insuevit pater optimus hoc me:
Ut fugerem, exemplis, vitiorum quæque notando.
Cum me hortaretur parce, frugaliter, atque
Viverem uti contentus eo quod mi ipse paressem,
Nonne vides Albi ut male vivat filius? atque
Barrus inops? magnum documentum ne patriam rem
Perdere quis velit." *Hor. Serm.* i. 4.

during the last war, they arrive at the sweeping conclusion, without looking into the circumstances of the case, that such institutions are essential to the welfare of the community, and that commerce is increased by foreign war. But previous to any inference being made, men should not only regard things as they are, but look to the causes which produce them, and endeavour to discover their mutual independence. If the uniformity seem to be connected with no law that we can discover, the extent to which it is to be relied upon, is simply a case of calculation by the ordinary laws of probability: where, however, it appears as the result of a causal tie between the sequential or concomitant phenomena, the laws of which, however, we cannot calculate, we may regard the uniformities as universal laws, and predict their occurrence in all instances which do not present counteracting obstacles to their agency. The discovery, however, of such conflicting agencies, and the nature of the law on which the uniformities themselves depend, are necessary to raise them out of the category of conditional truths, and invest their prediction with scientific certainty.

Analogical evidence, in a strictly moral sense, comprises that kind of inference which is drawn from mere resemblance of relations[1]; as if from the assumption that the colonies stand in the same relation to the mother country as a child to its parent, any one were to argue that unconditional

[1] "Every one knows," says Bishop Berkeley, in his Minute Philosopher, "that analogy is a Greek word, used by mathematicians to signify a similitude of proportions. For instance, when we observe that two is to six in the same proportion (ratio) as three is to nine, this similarity or equality of proportions (ratios) is termed analogy. . . . The schoolmen tell us that there is analogy between intellect and sight; forasmuch as intellect is to the mind what sight is to the body; and that he who governs the state is analogous to him who steers a ship." It would, however, greatly contribute to philosophical exactness if the word were confined to one of the three senses for which it is now too indiscriminately used. We have called, in conjunction with most metaphysicians*, the grounds of analogy those on which the physical sciences rest. If this term be accurate, another ought to be found to distinguish resemblance of qualities, and a third, distinct from the two preceding, to express similarity of relation. While the three meanings are huddled together under one name, confusion of ideas must inevitably ensue.

* See Foundations of Evidence, p. 171, with note.

obedience to all the degrees of the central authority was the clear duty of the colonists; or from the similarity of relation existing between a nation and its rulers, and a joint-stock company and its board, that the people were perfectly at liberty to choose their own governors, cashier them for misconduct, and in case of need to frame a government for themselves. In this narrow sense, however, analogy is rather suited for illustration than argument, nor can we adduce any example in which its force arises above that of weak probability. Arguments which arise from the direct similarity of things are weak enough when the evidence does not amount to a complete induction; but when we introduce the element of the similarity of relation of things, the amount of probability dwindles in rapid proportion, and exhibits an inherent inferiority of conclusiveness.

It, however, very frequently happens that analogical argument is capable of meeting both cases, and rests its inference not only on similarity of relation, but on the direct resemblance between the things themselves. As an instance of the high conclusive force which double analogies of this kind are capable of attaining, we may adduce Butler's famous argument in favour of the divine origin of Christianity. The proof may be said to consist in close compact inference from the resemblance of the system of nature and the economy of God's visible dispensation in the natural world, to the system of religion and the economy of God with regard to the present and future state of our moral being. We may also regard it as an argument by strict analogy, inferring the truth of the Christian religion from the fact that it puts forth the same relations to man and its author as the system of nature. If we grant, therefore, that God created nature, we cannot well avoid the conclusion that the Christian scheme, so similar to it in its deepest and broadest relations, should have sprung from the hands of the same artificer. The force, however, of the argument in the last case is derived from the strength which attends it in the former, or may be said to be confounded with it. From the evidence of design and profound adaptation of parts to meet certain ends which the Christian religion exhibits, we infer its divine origin, just because similar evidence in the case of nature has led mankind to the conclusion that it came from God. The conclusiveness of the proof does not proceed from mere similarity of relation, but from the

fact of that resemblance arising out of vastness of design, and intricate and elaborate co-ordination of parts with reference to a constituted whole which mark both systems, and stamp them as the works of the same author. The degree of confidence to be placed in this and similar analogical arguments will depend, of course, on the amount of similarity as contrasted with that of dissimilarity involved in the case, taken in conjunction with the extent of our knowledge of the individual subjects whose properties are compared. If the unexplored region of unascertained properties be large, or if we have reason to think that many remain concealed whose discovery might affect the probability to which the recognised resemblances point, faint stress indeed should be laid upon the evidence.

Notwithstanding the argument of analogy in the cases already contemplated, is never able to reach above a high degree of probability, it may occasionally form the ground of rigid scientific inference in disproof of the position of an adversary. Though it cannot help the philosopher to a certain conclusion on any one point, it can enable him by means of what the ancients called *ἔνστασις*[1], to demolish every position which his adversary takes up against it. Evidence which may be inadequate to establish a complete inference, may be amply sufficient for refutation. If the peculiar character of the subject prevented Butler from demonstrating with scientific rigour the divine origin of the Christian faith, he, at all events, annihilated, with the analogical weapon, the position assumed by the deists of his day, viz., that the Christian religion could not be true since it contradicted and falsified the natural presumptions and intuitive convictions of mankind, by proving that the system of nature involves difficulties of no less startling a character. He thus overthrew a falsely assumed principle by the allegation of an unanswerable fact[2].

[1] Instance brought forward to disprove the general principle of an adversary. See Karslake's Aids to the Study of Logic, vol. ii. p. 83.
[2] Butler himself seems to have regarded his argument in this light, for he writes:—"If there be an analogy or likeness between that system of things and dispensations of Providence which revelation informs us of, and that system of things and dispensation of Providence which experience, together with reason, informs us of, *i. e.* the known course of nature, this is a presumption that they both have the same

BOOK VI.

FALLACIES.

PROEMIUM.

As we have followed the reasoning process in every diversified combination it assumes in science, and laid bare the mechanism by which every description of scientific truth is reached, it only remains for us to notice the variety of illusions to which the process is exposed,—the different forms in which error is capable of simulating reason and deceiving mankind. To some extent, indeed, this has been already performed. At every stage of the scientific process certain errors were to be guarded against and corresponding deceptions pointed out; yet, since many remain unnoticed, and all are more or less connected in a chain of mutual dependence and relation, it becomes essential to a scientific view of the subject, to allot to them a distinct portion of the treatise.

Fallacies are commonly divided into two grand classes according as they interfere either with the canons of the syllogism; or introduce false premises, or lead to a conclusion different to that of which proof is required. The first are called fallacies *in dictione*, or formal fallacies, in which the conclusion does not follow from the premises. The latter are termed *extra dictionem*, or material fallacies, which are good as far as the reasoning is concerned, but false as to the matter, the premises being either wrongly assumed, or the conclusion foreign to the subject. The first kind may be considered under two heads. The fallaciousness of some being evident from the bare form of the expression, without regard to the meaning of the terms, such as undistributed middle, illicit process, and negative premiss; while that of others requires the material sense of the middle term to be inquired into before the ambiguity can be cleared up, which happens in all cases of ambiguous middle term, except its non-distribution. Of

author and cause; at least so far as to answer objections against the former being from God, drawn from anything which is analogical or similar to what is in the latter; for an author of nature is here supposed." Introduction to the Analogy. See Karslake's Aids, &c., vol. ii. p. 83.

these we shall treat in two chapters under the head of formal fallacies and fallacies of language.

The material fallacies, in their moral and physical relations, may be ranked under premiss unduly assumed, and irrelevant conclusion. The former class will lead to the consideration of *non causa pro causa* in all the various phases it is capable of assuming in both order of sciences, as incomplete enunciation, groundless assumption, false analogies, and *petitio principii*, or the assumption of a premiss, either identical with the conclusion or unfairly implying it. Irrelevant conclusion will comprise that large magazine of fallacies so commonly drawn upon by vulgar dialecticians, such as appeals to the passions, shifting ground, eternal raising of objections, and use of complex terms, which enable the dialectician, while employing the same words, to make out his case in a sense quite foreign to the matter in dispute. An additional chapter on this branch of fallacies will exhaust the subject.

There is no fallacy which does not fall naturally under one of the foregoing heads. Even those sophisms which arise from self-love, interest, or passion, and which so powerfully influence civil concerns, ordinarily involve some of the intellectual obliquities above referred to, and are capable of being hunted out and condemned on the same grounds. The idola of Bacon might appear to be fallacies of another genus, and have been so characterised by Dr. Whewell; yet, on a close analysis, they will be found mere exemplifications of the fallacies above enumerated, only expressed in a more popular form. For, what else is characterised by Bacon's illusions of the Forum (idola Fori), but the common ambiguities of language; or what other thing does he caution his readers against, under the name of illusions of the tribe and illusions of the den (idola tribus, idola specus), but the fallacies of groundless assumption and unwarrantable induction? In reality, no fallacies have risen out of the application of the inferential process to modern science, which had not been already provided for under the heads of the old logical division.

It must not be assumed, from the strict manner in which we have laid down the boundaries of the different fallacies, that each is only capable of being referred to one distinct

head. It occasionally happens that one fallacy may present so many different aspects, according to the light in which it is looked at, as to be referable to one or two heads, under both the formal and material division; in which case, the only resource is to place it among that class to which it bears the nearest kinship. This is most frequently the case with dialectical fallacies, where the sophist either envelopes his false principle in a variety of disguises, or avoids its distinct statements in the elliptical language of ordinary reasoning by a suppressed premiss, leaving his hearers to supply one which is either untrue or does not establish the conclusion. In the latter case the fallacy may not only have as many relations to one genus as another, but, until the sophist has drawn his inference, it remains a matter of doubt to what particular head it may be referred. For example, if a man, after dwelling on the abuses of religion, proceed to infer that the system so deformed is false, we must suppose him to assume either that every power distorted from its natural uses cannot come from God, which is a palpable falsehood, or that every false religion is corrupt, which, however true, proves nothing, the middle term being undistributed. Now, in the former case, the fallacy would be referred to the head of *extra dictionem;* in the latter, to that of *in dictione.* It is a matter of no concern to the sophist whether his hearers assent to the false premiss or to the unsound syllogism, as long as they can be brought to admit the conclusion[1].

CHAPTER I.

FORMAL FALLACIES.

§ 1.—*Illicit Process and Undistributed Middle.*

To this head may be referred all those forms of reasoning which violate any of the canons of pure inference, as laid down in the book on syllogisms. Of this kind is the fallacy so much in vogue of supposing the conclusion false because the premiss is false, or because the argument is illegitimate;

[1] Whately's Logic, chap. v.

as if any one should show the futility of an argument advanced to prove the Divine existence, and thence infer that God did not exist. In reality, the discarded argument ought to go for nothing: its refutation proves nought beyond its individual weakness, nor can it be extended further without involving an illicit process of the major. Thus, supposing the existence of God was rested on the universality of the belief, and a nation was adduced as destitute of belief, the sophism by which such a refutation would be erected into a disproof of the existence of the Deity would be—Whatever is universally true must be believed; the existence of God is not universally believed, therefore it is not true; in which *true* is taken universally in the conclusion, and only particularly in the major premiss. In like manner, others are inclined to infer the truth of the premises from that of the conclusion, which involves the fallacy of undistributed middle: As what is universally believed is true; the existence of God is universally believed, therefore it is true; where the term *universally believed* is taken twice particularly. Yet it may be fairly assumed, if an able reasoner produce no other arguments in defence of his position than such as are easily exploded, that his opinions are untenable, and that the converse of his doctrine is true. Hence no greater damage can accrue to a cause than to leave its defence in the hands of feeble advocates, since ordinary people take their exposition as an accurate measure of all that can be said in its favour. Nothing is more common to persons who are fluctuating between two sets of tenets, than to become firmly attached to one of them through hearing a weak-minded advocate argue against them.

Another fallacy akin to the present is mistaking a contrary for a contradictory proposition, or inferring, against the rules of opposition, that because one view is false its contrary must be true. Thus, if any one were to argue from the fact that the cholera was a visitation from God, that its causes did not depend upon any physical laws, he would fall into a fallacy of this kind. For there is not such direct opposition between the two cases that both cannot be true together, which is the law of contraries. In fact, the probabilities are strongly in favour of the latter supposition; since we know nothing of pestilence that may not be traced to some

kind of material agency, though we cannot lay our hands upon the precise combination of causes in which some of them take their rise. This fallacy appears in the form of undistributed middle. Whatever does not depend on physical laws is a visitation from God; the cholera is a visitation from God; therefore it does not depend on physical laws.

It may be observed, that the infraction of the rules of hypotheticals—viz., proceeding from the denial of the antecedent to that of the consequent, or from the establishment of the consequent to the affirmation of the antecedent, also involves illicit process of the major and undistributed middle. Thus, if the existence of God be universally believed, it must be true; but it is not universally believed, therefore it is not true; and if the existence of God be true it must be universally believed, but it is not universally believed, therefore it is not true.

CHAPTER II.

VERBAL FALLACIES.

§ 1.—*Ambiguous Middle.*

IN the case of undistributed middle, the extremes of the syllogism are compared with two different parts of the same term: we have now to consider a series of fallacies in which the middle, being used in two different senses in the two premises, is compared with two different terms. The first class of them may be referred to the head of fallacies of equivocation. Of this kind is the argument of Plato[1], which is generally taken up by those who advocate a system of national education as a panacea for everything: No one desires evil knowing it to be so; to do wrong is evil, therefore no one desires to do wrong cognisant of the true nature of what he desires, but only in consequence of ignorance. No one could assent to the major unless the term evil were restricted to that class of objects which either interfered with our own happiness, or frustrated that of others in matters where our own interests were not con-

[1] In his Gorgias.

cerned. In the minor, however, the term is taken in its most general sense, and being in that character applied to the major term, leads to a palpably wrong inference. Yet from this argument Plato inferred that virtue is a branch of intelligence, and is to be produced by intellectual cultivation; and made the proposition the basis of his ethical system, in which he was followed by most of the philosophical schools among the later Greeks[1]. With a similar "paltering with words in a double sense" were the arguments of the ancients relative to the *summum bonum* infected, the word *good* being at one time intended to mean what was good for oneself, and at another what was good for other people. The proper mode of dissipating such verbal ambiguities is by drawing a distinction, and granting or denying the proposition according to the different meanings implied in the statement. Of the use of this instrument the scholastics were the most powerful masters; and it still furnishes in the continental universities one of the most powerful weapons of theological controversy.

Another example of ambiguous middle may be instanced in the argument by which many set themselves against a judicious reform of the electoral system. Thus, whatever interferes with the influence of property is pernicious; the measure in question interferes with the influence of property, &c. Now, the major should never be accepted in an unrestricted sense; because property may exercise a pernicious as well as a beneficial influence, according as it is administered; and if the proposed measure simply tended to deprive the possessor of property of the power to abuse his influence, the objection would, of course, fall to the ground. There are a class of words which, from being indiscriminately applied to distinct meanings, are peculiarly liable to lead those who employ them into fallacies of this character. Of this kind is the word *same*, which sometimes denotes similarity, but is as often employed to point out identity; as when we say: "The same person whom we observed yesterday," we do not mean an individual resembling the one whom we saw in dress and features, but the same identical person; but if the word is applied to a house or a stone, the expression by no means signifies identity, but

[1] Mill's System of Logic, vol. ii. p. 446.

mere similarity of relation. From this double signification of words arise frequent cases of ambiguous middle, as in the argument of Bishop Berkeley to prove the existence of an eternal mind: "Ideas cannot exist without a mind in which they inhere; I have the same idea to-day as I had yesterday; but this would be impossible, unless there was a mind in which it could exist during the interval of its absence." Here Dr. Berkeley confounds, under the word same, resemblance with identity, and uses the term in the latter sense when he ought only to have employed it in the former[1].

Occasionally this fallacy assumes the form of an interrogation, in which many questions are asked under the guise of one; so that whatever answer is given the sophist may bring under the response the cases to which it does not apply. To detect the ambiguity it is necessary to answer each question separately. Thus, the question discussed by Cicero in the third book of the *De Officiis*, whether anything vicious is expedient, belongs to the fallacy of interrogation; from the ambiguity of the word expedient, which sometimes means conducive to temporal prosperity, sometimes conducive to the greatest good. Now, if the reply to this question be in the negative—that is, if the latter sense be applied to the word expedient, it is the custom of the sophist to introduce the former. For example: What is vicious is not expedient; whatever conduces to wealth and aggrandisement is expedient; therefore it cannot be vicious. If the response be affirmative, of course the order will be reversed: Something vicious is expedient; whatever is expedient is desirable; therefore something vicious is desirable.

Another group of fallacies under this head arises from men taking for granted that paronymous words—*i. e.* those which spring from one root—must convey exactly the same meaning. This assumption is of common occurrence, as few express the terms in precisely the same words throughout the discourse, but continually vary them to suit the structure of the sentence, and to divest their style of a pedantic air. Nor is the practice at all illogical, so long as the variety of expressions in which the terms are clothed point to the same identical meaning; but since paronymous terms do not invariably do so, the assumption, when not carefully watched,

[1] Mill's System of Logic, vol. ii. p. 451.

is often likely to mislead. Thus, if any one inferred from the fact that theorists and projectors are unfit to be trusted, that his neighbour ought not to be trusted because he has formed projects or theories; he would imply that the bad sense which we attach to mere theorists and projectors is equally applicable to any one who forms theories and projects, which is by no means the case. It is not indispensable to sophisms of this kind that the fallacy lurk in the middle term. Though classed under that head, it may lie in one of the terms of the conclusions. Thus: To be acquainted with the guilty is a *presumption* of guilt; this man is so acquainted, therefore we may *presume* that he is guilty. This argument proceeds on the supposition of an exact correspondence between *presume* and *presumption*, which, however, does not exist; for *presumption* is commonly used to express a kind of slight suspicion, whereas to *presume* amounts to absolute belief[1]. Such fallacies being built on the grammatical structure of language, are usually termed *Fallacia figuræ dictionis*.

As an additional instance of this class we may cite the use of the word representative, which, from the verb which forms its root, is taken not unfrequently to mean, in the case of a member of a legislative assembly, a person who is bound to represent the exact opinions of the majority of his constituents on all points, and never to act on his own responsibility; whereas, law and usage has defined the term to mean one who is chosen to represent the interests of a certain constituency according to the best dictates of his own judgment, and unbiassed by any undue extraneous influence. Such a person may consult the opinions of his constituents before making up his mind on a question that may concern them, but he is not bound either to be their spokesman, or resign his seat, though he may pursue the latter course from motives of delicacy.

Under the head of ambiguous middle may be ranked the fallacy of division, which consists in the middle term being used in the major premiss collectively and in the minor distributively; and the fallacy of composition, which simply reverses this order, taking the distributive sense first and the collective sense after. Of these the most glaring examples

[1] Whately's Logic, ch. v.

are: Seven is one number; five and two are seven; therefore five and two are one number; or the reverse: Five and two are two numbers; seven is five and two, therefore seven is two numbers. Of the last kind is the Owenite fallacy, directed against the doctrine of human responsibility: He who necessarily goes or stays is not a free agent; you must necessarily go or stay, &c., in which the major is "he who is compelled to go or compelled to stay, is not a free agent," which can be readily conceded; but as the minor changes the middle term into sheer compulsion to take the alternative of these two courses, the conclusion is abortive. Such, likewise, is the fallacy which leads many to speculate in lotteries, which is thus stated by Dr. Whately[1]: The gaining of a high prize is no uncommon occurrence; and what is no uncommon occurrence may reasonably be expected; therefore the gaining of a high prize may reasonably be expected. The conclusion, being evidently confined to the person who makes the inference, must mean "reasonably expected by a certain individual;" therefore, for the major premiss to be true, the middle term must be understood to mean, "no uncommon occurrence to some one particular person;" but the minor, which has been placed first, can only be true in the sense of no uncommon occurrence to some one or other, and thus gives rise to the fallacy of composition.

This fallacy is of frequent occurrence in civil concerns, as is instanced in the mode in which people lose sight of the aggregate results of acts in their separate insignificance. Thus the profligate forgets while he infers that each single indulgence can be of little harm to his constitution, that the collective amount may undermine its vigour; nor do the avaricious seem to be aware, while they attempt to convince their own conscience and others that they are not bound to subscribe to this or the other benevolent institution, that the practical conclusion which they draw is that all charity may be dispensed with.

The last verbal fallacy we shall notice is the *fallacia accidentis*, together with its converse, *fallacia a dicto secundum quid ad dictum simpliciter*; in each of which the middle is used in one premiss to signify something considered in its absolute essence, and in the other to imply, besides its simple nature,

[1] Logic, ch. v.

the accidents and relative conditions it is liable to assume. Thus, in the *fallacia accidentis* we draw a simple, unrestricted absolute conclusion from one that is only true by accident, as if we were to decry antimony because (on account of its misapplication) it produces bad effects; or to attribute to eloquence all the evils to which its abuse leads; or to medicine the errors of certain ignorant practitioners. Of a similar kind is the fallacy of the epicureans, who concluded the gods must have human form, because, among all creatures in the world, men alone had the use of reason. The gods, said these philosophers, are very happy; none can be happy without virtue; there is no virtue without reason; and reason is found nowhere except in the human form: it must be avowed, therefore, that the gods have the human form. Reason, however, is not essential to the human form, but only accidentally connected with it: it was, therefore, puerile to conclude that because the gods were endowed with mind they must also have hands, feet, and other human appurtenances. The converse fallacy of passing from what is true in some respects to what is true absolutely, may be instanced in another argument of this school of philosophers to prove the same proposition. The gods must be invested with the human form, because that form is most beautiful, and everything beautiful must be in God. For, as the human figure is not beautiful absolutely, but only in relation to bodies, it does not follow that it must be in God, who is only the inheritor of absolute perfection: *i. e.* perfection without any imperfection. The following is a similar fallacy, which Cicero puts into the mouth of Cotta to disprove the existence of God: If God exist, he must be in possession of all virtue; but we can attribute no virtues to God like those in men, therefore no deity exists[1]. It did not

[1] "How," says Cotta, "can we conceive God, since we can attribute no virtue to Him? For shall we say that He has prudence? But since prudence consists in the choice between good and evil, what need can God have for this choice, not being capable of any evil? Shall we say He has intelligence and reason? But reason and intelligence serve to discover to us that which is unknown from that which is known. Now there can be nothing unknown to God. Neither can justice be in God; because this relates only to the intercourse of men; nor temperance, since He has no desires to moderate; nor strength, since He is susceptible of neither pain or labour, and is not exposed to any danger. How, therefore, can that be a God which has neither intelligence or virtue?" Cicero, Natura Deorum, b. iii.

strike the framer of this argument that there was just a possibility that virtue in man might only exist in a relative state from the imperfection it exhibits, and that the source from which it was derived might be traced back to its full plenitude in God. To deny that there is no virtue in God, because the imperfect virtue which exists in man cannot be ascribed to Him, is tantamount to the assertion that because no rivers can exist in the sea, the ocean has no water; or is equivalent to saying that the fact which proves God to have no intelligence is that nothing can be hid from Him; that, in other words, He sees nothing, because He sees everything; that He can do nothing, because He can do everything; that He enjoys no happiness, because He possesses all happiness. It is, as if a rustic, who having never seen any houses but those covered with thatch, and having heard that there were no roofs of this nature in towns, should conclude that there were no houses in towns, and that the dwellers in them were exposed to all the inclemencies of the weather.

CHAPTER III.

MATERIAL FALLACIES.

§ 1.—*Non Causa pro Causa. Fallacy of Groundless Assumptions.*

The largest group of material fallacies may be assigned to undue assumption of premiss; which is in fact the cause of nearly all the sophisms which have obstructed the progress of science, either in the shape of incongruous theory, false objections, or any erroneous statement of fact. The false premiss is not unfrequently introduced as a thing quite indubitable, of which mankind never ventured to exercise the slightest doubt; just as Charles the Second made the members of the Royal Society believe, that a live fish did not increase the weight of any vessel of water in which it was placed, by requesting an explanation of the phenomenon *as a real fact.* Sometimes the groundless statement is introduced as "a well-known fact, universally admitted," or "a circumstance not a little remarkable;" or it may be covertly insinuated, by way of illustrating the pretended fact which is so assumed. Thus, the opponents of

Copernicus argued that the earth did not move; because, in that event, a stone let fall from the top of a high tower would not reach the ground at the foot of the tower, but at a little distance from it, in a contrary direction to the earth's course. In *the same manner* (said they) *as a ball when dropped from the mast-head of a ship in full sail does not fall exactly at the foot of the mast, but nearer to the stern of the vessel.* The Copernicans might have silenced these objections by dropping a ball from the mast-head; as it turned out upon actual experiment that it does fall at the foot as the theory requires. But the spurious fact was so plausibly stated that the Copernicans admitted its truth, and struggled vainly to make out a difference between the two cases.

To this head may be referred that wide class of fallacies which ascribes objective existence to abstractions. From the abstract principle that nature abhors a vacuum, philosophers formerly taught that vessels full of water break when they freeze, and by the contraction of the water leave a vacuum which nature cannot endure. It has, however, been discovered that the fracture arises from a contrary reason; since water when frozen occupies more space than in a state of fluidity, and consequently breaks the vessels which do not afford room for the expansion. Of a similar nature were the abstractions which corroded the bulk of the Aristotelian physics; such as the abstract perfection of circular motion, by which the Stagyrite attempted to prove that the planets move in perfect circles; and the assumption that generation and corruption only happen between contraries, which led him to infer that the heavenly bodies were incorruptible, simply because circular motion had no contraries[1]. Extreme instances of this tendency to substitute *à priori* conceptions for actual realities, may be found in the abstract notions by which many of the ancients sought to resolve the principles of the universe. Some placed the explanation of all phenomena in the "*το απειρον*," or infinitude of things; others in the *το ὀν* and the *το μη ὀν*, that is to say, in entity and nonentity;—while an authority, which was destined to command opinions for nearly two thousand years, settled this important point by deciding that matter, form, and privation were to be considered the principle of all things.

[1] Galiléo Systema Cosmicum, Dial. i. p. 30.

Another prejudice that leads to the fallacy of groundless assumption, is the notion that differences in nature correspond to distinctions in language; extreme instances of which may be found in modern as well as in ancient inquiries. With the Greeks, however, this fallacy was most conspicuously prominent, partly on account of the philosophic structure of their own language, which led them to imagine that all its generalisations of natural phenomena were exact transcripts of reality; and partly because their own ignorance of every other language debarred them from perceiving the true functions of language, or from drawing a distinction between terms loosely abstracted from things by vulgar perception, and others which had been scientifically invested with a determinate connotation. Hence they never dreamt it was necessary to distinguish things which their language confounded, or to combine objects that the popular phraseology of the country had kept apart; but they set on analysing and sifting the general terms of their language, as if the vague notions they embodied, had been formed by some inspired process, and warranted by Heaven to reflect the exact reality of things. Accordingly, when Thales was asked what is the greatest thing? he replied, Place; for all other things are in the world, but the world is in it. In Aristotle we have the consummation of this mode of speculation. Thus, in inquiring into the existence of void, or empty space, he enumerates the different senses in which we say one thing is contained in another. For example, the part is in the whole, as the finger is in the hand; the species is in the genus as man is included in animal; the government of Greece is in the king, and various other senses are exemplified, but of all these the most proper is when we say a thing is in a vessel, or, generally, in a place. Then examining what place is, he comes to the conclusion that if about a body there be another body including it, it is in place, and not, if otherwise. Proceeding, then, to the question of a void, he, as usual, examines the different senses in which the term is used, and adopts, as the most proper, place without matter. He then proves that so blank a thing cannot exist, from such arguments as these: In a void there could be no difference of up and down; for as in nothing there are no differences, so there are none in privation or negation; but a void is merely a privation or negation of matter; therefore,

in a void bodies could not move up and down, which it is in their nature to do. When we compare such attempts to extract facts out of the loosest forms of language with the scientific reasoning of our day, we may cheerfully allow the ancients their decided supremacy in the walks of sculpture and eloquence, in consideration of our more splendid dominion over nature.

We are not unfrequently led to take our own conceptions of the possible, as furnishing the actual limits to which its boundary extends; nor is this unfair, if the things we place outside the line be really impossible, in the light of being absolutely inconceivable without over-riding some of the elementary principles of the thinking faculty. Thus it would be by no means wrong to assume that the same object cannot be in two places at the same time; that something can spring out of nothing; or that the laws of number can be otherwise than what they are. But the evil is, that men confound this strict sense of the word impossibility, with that which belongs to what is purely inconceivable; on the score of the matter which is placed in that category being entirely strange to them, and requiring some strain on their conceptions before they can bring their mind to entertain it. Thus St. Augustine denied the existence of the antipodes, because he could not see how it could be brought about; and Bacon rejected the Copernican system simply because he could not conceive so great a void in the celestial regions as that system assigns to them. In like manner the Cartesians waged war against Newton's law of gravitation, assuming the principle that a thing cannot act where it is not; and so plausible did the objection seem to that great astronomer, that he imagined a subtile ether to line space, through the medium of which the attraction of the various planetary bodies might be conveyed to each other. "It is *inconceivable*," said Newton, in propounding this theory, "that inanimate brute matter should, without the mediation of something else which is not material, operate upon and affect other matter without mutual contact. . . . . That gravity should be innate and essential to matter so that one body should act on another through a vacuum, is to me so great an absurdity that I believe no man who has a competent faculty of thinking in philosophical matters can ever fall into it." It does not appear to have struck Newton, that with regard to

the mere inexplicability of the phenomena, that motion by impact is quite as mysterious as impulsion at a distance, with no intermediate agencies between; and that since the latter, as we are fully assured, is the ordinary mode by which one spiritual substance acts upon another, we can find no difficulty, if circumstances require it, to invest material substances with a similar property.

The same conception of impossibility has been at the bottom of most of the absurd theories of modern times, from the vortices of Descartes to the Neptunian system of geology. In metaphysics it has exercised rampant sway, as may be witnessed in the theories of Malebranche and Leibnitz to account for the conformity of states of mind with peculiar dispositions of bodies without direct contact, which these philosophers believed impossible. Leibnitz attributed the fact of such dissimilar substances acting in concert to a "pre-established harmony" existing between them; which caused their motions to beat always in unison, just as two clocks which, though unconnected, strike simultaneously, and always point to the same hour. Malebranche's theory of "occasional causes" was a refinement on this conception. Instead of supposing the clocks originally arranged so as to strike together, he held that when the one strikes God interposes, and makes the other strike in correspondence with it.

No prejudice is so apt to lead men to assign real causes in nature to the agency of pure chimeras, as that of mistaking their subjective notions for objective laws; as may be witnessed to a great extent in astrologers, who, referring every natural production to the influence of the stars, made out that there must be an immoveable heaven beyond the celestial orbs, because the earth produces different things in different countries; just as if India could not produce ivory, and Sabea precious drugs, and Italy wine and oil, unless there were an immoveable heaven to present a diversified and unchangeable aspect towards different portions of the globe. To the influence of this prejudice may be ascribed the popular notion, that the advent of comets and eclipses always portend great evils to subjects and princes; which has caused an infinite waste of stout prophesying and prediction to the no small terror of nations. Had the chronologies of Helvicus borne the most distant approximation to truth, Rome would have been destroyed some scores of times; nor has it been for want of

similar forethought in modern times that Paris and London have not as often undergone the same fate[1]. The marvel, however, is not that direful mortalities and plague, or the death of some great potentate happen to coincide with the arrival of a comet or an eclipse, but that they fall out so often without them; for such celestial phenomena come round so frequently, that we are inclined to suspect by the laws of chance that wars and pestilence should be oftener associated with them. Moreover, there is no reason why causes so general and removed as these should have any considerable effect on the earth, or act at one point more than another, or threaten a king rather than a tobacconist.

With the latter class of groundless assumptions may be ranked the inclination to take refuge in omens and auguries as exponents of the future, which is so prevalent among the inferior orders of our day, and which exercised so potent an influence over the destinies of the ancient empires. Even Dr. Johnson would not go abroad on Friday, through a pre-existing notion that he must encounter misfortune; and we all know that no Italian host will dine thirteen together, or sit down with a party of eleven. If an ancient general missed his footing in landing on any expedition, the omen told so fearfully on the courage of the soldiers, that the chances of his success were considerably diminished. Hence Cæsar, who was much in advance of his time in all respects, on accidentally stumbling in effecting an embarkation on the African coast, had the presence of mind to convert the direful presage into a favourable one, by exclaiming, "Africa, I embrace thee." Frequently the omen took the form of a lucky or unlucky name, which the gods were supposed to send in prognostication of a future event. Thus the Greeks, as Herodotus tells us, were encouraged in their enterprise on their way to Mycale by the arrival of a deputation from Lamos; from the fact that one of the individuals comprising it was called Hegisistratus, or the leader of armies.

Another fallacy no less generally diffused, may be noticed in the practice of blending our own inferences with descriptions of what we have seen, so as to confound the conclusions

[1] What Cervantes did for the old romancers, Dean Swift accomplished for this class of prophecies: none have survived the renowned predictions of his Isaac Bickerstaff.

drawn from fact with actual observation. Thus it was stoutly maintained by the anti-Copernicans, that the system of the Danish astronomer could not be true, because they *saw* the sun rise and set; the stars revolve in circles round the pole; and they felt the earth to remain immoveable under their feet. But we now know that their alleged experience consisted entirely of inferences from a set of phenomena equally reconcileable both with the Ptolemaic system, and with that against which they objected. To the same absence of ability to discriminate between inference and the perception on which inference is grounded, may be attributed many of the marvellous stories by which posterity is astounded and amused. A wandering meteor in a churchyard is sufficient to call up in the mind of a rustic the presence of a supernatural visitor; nor could many observant travellers of antiquity get rid of the impression derived from the sight of some Africans in a state of abject abasement, that they belonged to a race of men whose heads grew out of their breasts, and not from their shoulders. It is singular to observe how full of conjectural inference is the most naked statement that can be wrung out of an illiterate person concerning the facts which he saw. He observes a sheet of lightning strike a house, and immediately asseverates his conviction that he saw a bolt drive in the wall, and not unfrequently goes in search of it. Every word in his description has its surmise, and each sentence is accompanied with a theory. So far, as Dugald Stewart observes, is a plain ungarnished statement of natural fact from being a result of nature, that the capacity to perform it may be regarded as unequivocal evidence of a mind trained by long and successful study to the most difficult of all arts, the interpretation of nature[1].

A common assumption, and one by no means confined to vulgar minds, is the habit of assigning anything as a cause which precedes another, or exists in casual connexion with it. Thus, because the wealth and power of the country increased under the old electoral system, and during the continuance of the Test Act, it was a standing argument with a large portion of the community when the abolition of such things were talked of, that the prosperity of England was owing to their influence. For a similar reason it has been assumed that

[1] Elements of the Philosophy of Mind, vol. ii. ch. ii. sec. 5.

the national debt is the cause of the national prosperity; that, because in mediæval times provisions were more equally distributed, a low degree of refinement is more favourable to the enjoyment of the masses of a community than a high state of civilisation[1]. In the same manner it was concluded that the star which is called the dog-star is the cause of the heat which prevails during the time of its ascension, and the increased mortality which attends its zenith in warm cities. Virgil himself, unless his language may be deemed figurative, was guilty of this fallacy when he wrote :

> Aut Sirius ardor:
> Ille sitim morbosque ferens mortalibus ægris
> Nascitur, et lævo contristat lumine cœlum.—*Æn.* x. 273.

Now if there were any truth in such conjectures, it would follow that in those countries where the situation of the star above the horizon is most perpendicular, heat should be the most severely felt; but so far is this from being the case, that its greatest altitude is accompanied with extreme cold. Such fallacies, though receiving a distinct name in the scholastic logic, as that of *post hoc, ergo propter hoc,* or *cum hoc, ergo propter hoc* are only violations of the cautions with which we have surrounded the method of agreement; and all infractions of similar rules with respect to the other methods may be regarded as so many distinct fallacies, and invested with corresponding designations.

§ 2.—*Incomplete Enumeration.*

One of the most common infringements of a principle affecting the validity of three of the experimental methods is that of incomplete enumeration, or of forming a conclusion upon the effects or causes of certain phenomena before examining all the circumstances in connexion with them. This is the fallacy of *inductio per enumerationem simplicem,* which Bacon censured as one of the primary sources of the errors which infected the ancient systems of philosophy. Men, after observing a few facts, grasped at the most sweeping generalisations, being impatient of the tardy results of passive observation, and having no idea of the experimental mode of investigation. Hence in everything which concerns natural

[1] Nov. Org. Aph. 46.

phenomena their theories went astray, as they assumed instances which nature either flatly contradicted, or failed to corroborate by actual fact. On such loose inductions Bacon attempted to throw ridicule by citing the case of an ancient sceptic who,—on being shown by a Pagan priest the register of those who had discharged the benefactions they had made to the gods on condition of their preservation from impending shipwreck, as a proof of the miraculous interposition of God,—drily asked, where were the names of those registered who, after making similar vows, had perished.

Yet instances of such loose reasoning are by no means wanting in modern times, even among men of great eminence, and are to be traced in many of the ordinary axioms of civil intercourse. Locke, for example, in his Treatise on Education, seriously advises all parents and governors of children to inure them to great hardship, dining them at all hours in the day, bathing them in snow during winter, and habituating them to long fasts and fatigues; because, he remarks, those who have undergone such discipline never fail to carry a robust body through manhood, and live to extreme old age: but had this distinguished metaphysician taken pains to collect the number of those who had died under the experiment, he would most likely have modified his opinion. Another instance occurs in the plausible notion so generally entertained by the old political economists, that men of lavish expenditure encourage industry, while the mere hoarder confers no benefit on society by his gains[1]. Here, then, are two sets of phenomena involved, one open and palpable to the senses, while the other lies under the surface, and cannot be reached unless by a penetration which, irrespective of sense, follows out things to their natural results. The fallacy consists, as most sophisms of this kind commonly do, in losing sight of the latent effects, and restricting the generalisation to mere sensible phenomena, as if they were the only instances concerned. The generous expenditure of the liberal is observed to feed labour, encourage industry, and stimulate the arts: every tradesman flourishes with whom they have connexion, and no misery is seen at their gates. It is, however, overlooked

[1] The first paradox was maintained by Coleridge, the second by Rousseau.

that the money of the avaricious, as far as the great masses of the community are concerned, is more usefully employed; for their savings, after passing into the hands of their banker, or having been invested in the funds, is lent to some merchant or manufacturer, and employed in hiring spinners and weavers, or opening some new channel of commercial enterprise, and thus gives occupation and bread to far more hands, at one venture, than the money of the generous employ during the whole of their career. But the careless observer does not see what becomes of the miser's money. The vulgar impression is, that it is locked up in an iron chest, which is not opened unless at the dictation of stern necessity; while the number of flourishing tradesmen that the profusion of the liberal feeds, is at once evident to the most obtuse vision; and this in so palpable a manner, that no one ever thinks of the far greater group of artisans whom it might employ in industrial and far more remunerative occupations. Hence comes the prejudice universal previous to the time of Adam Smith, and even not yet exploded among the majority of the educated classes, that prodigality encourages industry and parsimony oppresses it[1].

§ 3.—*Fallacy of False Analogies.*

Analogies, whether including similarity of relations or resemblance between the properties of objects themselves, are generally introduced in discourse either for the purpose of mere illustration, or of moving the intellect to the reception of certain opinions in the shape of direct evidence, or by way of argument and illustration combined. In the two latter cases only it falls under the cognisance of logic; the former branch of the subject belongs to the rhetorician.

An error in analogical reasoning may occur either in overestimating the probative force of the proof, or in asserting or implying resemblance in points which are essential to the argument, simply from resemblance in other features which are indifferent to it. It is to the last case that the fallacy in question more particularly applies. A common instance may be cited in the inference commonly drawn in favour of despotic government, from the similarity of relation which holds between a prince and his subjects and a father and his

[1] Mill's System of Logic, vol. ii. p. 400.

family. The common people of every community are always in a state of infancy, and since paternal authority is necessary to promote the happiness of children, it is argued that the superior sagacity of the prince ought to interpose by direct mandate to advance the welfare of his subjects. Nor would the inference be at all unfair, if the analogy agreed in the essential point which contributes to make paternal government the best possible form for the administration of private concerns—viz., the affection of a father for his family and his superior wisdom and experience. But it is just in this very point where it breaks down. For experience shows that we can never rely upon the existence of these properties in political despots; evil favourites in many cases getting between them and their subjects, and creating jealousies and misunderstandings which involve either one or both in ruin. Were parental management likely to be disordered by similar causes, the result would be anything but good government.

Another instance of this fallacy may be adduced in the common opinion that states, by the very constitution of things, have the same periods of infancy, manhood, and decrepitude that are found in the individuals who compose them,—that after the enjoyment of a certain amount of vigorous action decay must stamp its furrows upon empire just as it writes its wrinkles on the human body. Loose generalisations of this sort from history may furnish similitudes to illustrate or adorn; but if obtruded in the shape of analogies from whence to reason, they will occasionally be found upon examination rather to turn the argument the opposite way than make out the conclusion. Thus, in the present case, the decay of the vital powers in natural bodies are traceable to the spontaneous progress of those very changes of structure which in their earlier stages constitute their growth to maturity; while so far is this from being the case in political bodies, that the advance of those changes cannot, unless by palpable mismanagement, have any effect but the still further continuance of growth. Hence the analogy in question establishes an opposite conclusion to what it was intended to make out. For, if it prove anything, it certainly is this, that bodies politic can only die of disease or violent death; or, in other words, that they can have no old age.

This sophism, which scholastics termed *à non tali pro tali*, is generally allied with that of *petitio principii*, the analogy, which is the very thing to be proved before it can be adduced in evidence, being first assumed and argued from as if universally admitted. In this form it is frequently used to throw ridicule upon an opponent's reasoning, when he has incautiously let slip one or two loose expressions which admit of being illustrated by a burlesque parallelism. A ludicrous example of the fallacy in this guise may be found in the parliamentary debate on unlawful societies in Ireland, which took place in 1824[1]. "True philosophy," Mr. Mackintosh had said, in alluding to the word *hate* applied by the Catholic Association to the Orangemen of Ireland,—"true philosophy will always contrive to lead men to virtue by the instrumentality of their conflicting vices. The virtues, where more than one exist, live in harmony together. But the vices bear a mortal antipathy to each other, and furnish to the moral engineer the power by which he can keep them under control." "Admirable!" replied Mr. Canning; "but the poor man who has but one vice must be in a very poor way —no fulcrum, no moral power for effecting his cure; whereas his more fortunate neighbour, who has more vices than one in his composition, is in a very fair way, indeed, of becoming an honest member of society. How would the honourable gentleman like to have this doctrine introduced into his domestic establishment? If I had a drunkard in my household and dismissed him on account of this fault, it would be totally out of my power to recommend him to the honourable gentleman. But if I had the good fortune to discover he was also a thief, might I not with a safe conscience send him with an excellent recommendation, saying, I send you a man whom I know is a drunkard, but whom I am happy to inform you is also a thief; you cannot do better than employ him; you will make his drunkenness counteract his thieving, and bring him out of the conflict a very moral personage." This felicitous exaggeration is founded on a misconception of the word vice, confounding it with crime, and then selecting two cases which instead of being conflicting are in reality accessory to each other. It may be remarked that the most brilliant raillery of this logical statesman may be traced to a dexterous employment of analogical fallacies.

[1] Hansard.

There is no more effective weapon in dispute than the fallacy of *à non tali pro tali* sharpened with an ironical edge.

Under this head may be classed those fanciful analogies upon which many of the ancients founded physical theories, and which have drawn some of the moderns into inferences quite at war with common sense. Thus Pythagoras, finding that the relative distances of the planets bore an exact proportion to the divisions of the monochord, concluded that the action of these bodies in their orbitual motion gave rise to the fictitious music of the spheres[1]; as if the melody of the harp entirely depended on the proportion of certain distances between the strings, and not in the least on the sounding-board or wires of the instrument. It has been similarly held, that because certain combinations of numbers prevailed in some natural phenomena, they must run through the whole of nature; as, that there must be four elements, since there are only four possible combinations of hot and cold, wet and dry; that there must be seven planets, because there were seven metals, and even because there were seven days in the week. Kepler himself limited the number to six, simply because there were only five regular solids: besides, six was a perfect number that is equal to all its factors—viz., $2 + 2 + 2$ or $3 + 3$, which was an additional reason why there must be exactly six planets. The Pythagorians, in a similar way, were unanimous in thinking that the decimal number, as it surpassed most others in perfection, must be found in every celestial combination; and being acquainted with only nine heavenly bodies, to make up the enumeration, stoutly maintained that there was an antichthon or counter-earth on the other side of the sun invisible to us. Even Huy-

[1] Shakspeare's delightful allusion to this conceit in the Merchant of Venice will, no doubt, be familiar to many of our readers:

"How sweet the moonlight sleeps upon this bank;
Here we will sit, and let the sounds of music
Creep in our ears: soft stillness and the night
Becomes the touches of sweet harmony.
Sit, Jessica: look how the floor of heaven
Is thick inlaid with patterns of bright gold;
There's not the smallest orb which thou behold'st
But in his motion like an angel sings,
Still quiring to the young-eyed cherubims:
Such harmony is in immortal souls;
But while this muddy vesture of decay
Doth grossly close it in, we cannot hear it."—Act v. sc. 1.

gens was persuaded that when the number of the heavenly bodies had reached twelve, that further look-out was useless; —even Divine power could not go beyond that sacred number.

Of a similar kind was the assumption of the ancients, that because nature in many objects realised their abstract ideas of perfection, that a similar adherence to the most perfect imaginable entities ought to pervade the entire universe. This was a most convenient principle, which dispensed with all examination of instances, and enabled them to come to a conclusion upon the laws of any natural phenomenon with little expenditure of thought. Thus, if any action of nature was to be investigated, the ancients had only to ask themselves in how many possible ways a thing could be brought about, and select the most perfect, as the sure course which nature followed. For instance, because the heavenly bodies were perfect, they must move in circles, and that with uniform motion; for irregularity of movement would be censurable in men, and could not be tolerated in the celestial regions. Nor was the force of such reasoning lost upon some of the moderns; for the Copernicans alleged in favour of their system, that it placed fire in the centre of the universe, the only position which the noblest element could consistently occupy in conformity with that precedence given to dignity, and those customary rules of etiquette which prevailed in other parts of the universe.

§ 4.—*Petitio Principii.*

The fallacy of petitio principii, or begging the question, consists either in arguing in a circle or assuming a premiss which unfairly implies the conclusion. The theologian would furnish an instance of the first, were he to prove the authority of the Church from Scripture, and the inspiration of Scripture from the authority of the Church. To prove the existence of God on the same authority, or to argue that a government was good because we ought to support it, would afford an extreme instance of the second.

Notwithstanding Aristotle is very circumstantial in the description of this fallacy[1], no philosopher fell so frequently into it as himself. As an instance of his performances in this way, we may adduce his proof of the earth being the central spot of the universe:

[1] Arist. de Soph. Elenc. cap. xxvii.

The nature of heavy things is to tend to the centre of the universe, and of light things to fly off from it;
But experience proves that heavy things tend towards the centre of the earth, and that light things go off from it,
Therefore the centre of the earth is the same as the centre of the universe.

It is clear that heavy things tend towards the centre of the earth; but how could Aristotle deduce from this fact that they tend to the centre of the universe, unless by assuming in the major that the two centres are identical, which is the very thing he had to prove?

There is no fallacy in the category which is apt to put on more disguises, and to hoodwink men more readily into false principles, or to present them with more plausible reasons for their errors, than the assumption of the thing in dispute. Sometimes it appears in support of a bad generalisation to explain away the outstanding exceptions which conflict with the theory. Thus, when it was objected to the psychological system of Gall and Sphurzheim, that Voltaire (if the phrenological busts were accurate) had the organ of veneration very large; it was alleged by the phrenologists that the reverence of that philosopher for the Deity was so great that he scouted all existing forms of worship, simply because they fell below his idea of the majestic and sublime nature of that worship which befitted so great a Being. Goethe's deficiency in ideality, and Mozart's want of harmonic perception when judged by the phrenological standard, were accounted for in a similar manner. These individuals had the organs very large, but owing to the casual thinness of the plates of the skull, and the transparent tenuity of the muscle at that particular spot, the organ did not protrude on the upper surface. It is obvious that such a convenient system of answering objections amounted to this: The system of phrenology is true, therefore no exceptions to the theory exist which cannot be rationally accounted for, and proved to accord with it; which is one of the most glaring instances of reasoning in a circle that the vagaries of philosophy afford[1].

[1] These instances do not invalidate the entire system, but only the hasty generalisations which led its framers, in a night and a day, to assign to every inch of the cerebrum the precise feeling and faculty of which it was the organ. The tripartite division of the brain which this

Occasionally this fallacy comes before us in the shape of mistaking a sign of a thing for the thing itself—a mistake, however, of so gross a nature that it could not possibly pass current, unless a large space of time interfered as an agent in the deception. In past ages, for example, certain opinions were casually associated with peculiar interests, and though the interests have long been buried with the circumstances in which they had their origin, yet the opinions are still taken as presumptive proof of their tangible existence. A glaring instance of mistaking a sign, from which one might fairly infer a certain phenomenon, for a cause of it, occurred in the arguments of those who resisted Roman Catholic claims. The greater part of the enactment commonly known by the name of the Penal Laws, was framed at the epoch of the revolution, and was enforced with a view to discover the partisans of the Pretender. The creed of the Catholic, as Canning remarked, was not his guilt, but the means of detecting it. The creed was simply a sign or badge of those who had a leaning to a prince outlawed by the constitution. But to uphold the penal laws after the attachment had expired, and the political danger passed away, was, as if a magistrate having received information that a murder had been committed by a man who wore spectacles and a wig, and having apprehended a man distinguished by these appendages, should, upon its being ascertained that no murder was committed, still refuse to relinquish his man, persisting that the spectacles and the wig were conclusive evidence of the murder. All believers in transubstantiation being suspected of an attachment which the law deemed treasonable to the possessor of the throne, their creed was taken as a certain badge of the treason, and exposed its professors to severe punishment. But when the foreign attachment with the exiled family had ceased, the Catholic was punished for believing in transubstantiation.

One of the most notable disguises which this fallacy puts on, is to assign as the original cause of a thing in dispute an effect or collateral consequence of the very principle which is sought to be explained away. By such a procedure Gibbon endeavours to undermine that part of the evidence adduced

system assumes, cannot, we think, be doubted; but, then, it had been pointed out long before by Galen, and was a favourite theory of Hippocrates.

to prove the divine origin of Christianity, which is derived from the marvellous speed with which it subjected the world to its tenets. We need no miraculous interposition, argues the historian[1], to account for what is fully explainable by human agency; and he immediately collects under distinct heads the causes which had conjointly operated to the wild-fire spread of the Christian doctrine. The principal of these are—the pure lives of its professors; the inflexible firmness with which they adhered to their principles, despite of rack, gaol, and all the horrid instruments of death; the zeal they manifested in the propagation of their doctrines, and the subserviency of all other views to that end; the social bond of brotherhood perpetuated among their members, and the regularities of daily worship. But Gibbon forgot in stating these and similar reasons as *natural* agents in the spread of Christianity, that he was assuming the very thing in dispute. It is obvious that the features he alleged so far from being natural, were about the most startling phenomena that could present themselves in a corrupt state of society corroded by moral pestilence of every kind: so that his pretended proof leaves the swift propagation of Christianity quite as inexplicable on human grounds as it was before. This kind of explanation is not a whit better than the light let in upon the foundations of the earth by the cosmogony of the Indians. "The world rests upon an elephant, and the elephant upon a tortoise," say the Brahmins. But, then, what does the tortoise rest upon?

A similar instance of this fallacy in its most concealed guise is presented in the reasoning, by which Hobbes and Rousseau rest the mutual obligations of members of a civil community upon a supposed social compact, apart from all motives of utility and interest. According to the latter, sovereigns are compelled to provide for the welfare of their subjects, and subjects are bound to maintain dutiful allegiance to their sovereigns, by the terms of a contract entered into by their barbarous progenitors in renouncing savage life, and agreeing to establish a political society. In the same manner Hobbes, throughout his Leviathan, deduces with elaborate skill, the obligations which men are under, to obey even the most despotic mandates of their rulers, from a promise made by their ancestors, at the foundations of society, to leave their

[1] Decline and Fall, ch. xvi.

destinies in their hands. A great deal of good ingenuity, however, might have been spared by these philosophers had they reflected that even if the compact had been drawn out in precise terms, and the document on which it was written hermetically sealed, and transmitted to future generations, it could only have bound the race of men who subscribed it. In no further case could it have held without the admission of the very principle of expediency and interest they discarded as a ground of obligation. Thus we are forced back by the conclusion they adopted, to the enunciation of the operating motive their reasoning endeavoured to exclude. To have established that conclusion, they should have proved not only that a social compact did exist, but that it was an all-sufficient ground to link generations of men together in support of the same institutions and the same line of policy. But they assumed this which was the radical point in the argument, and consequently proved nothing.

Occasionally this fallacy masks itself in mere forms of expression, either assigning as a reason for a thing expressed in the abstract the same thing re-stated in the concrete, or making the concrete statement first, and then alleging as proof, the same thing expressed in a concrete form. Thus the loadstone attracts amber by reason of its magnetic virtue; the poppy has a soporific virtue because it lulls to sleep. These sort of pretended explanations, though ungallantly termed *ladies' reasons*, are by no means confined to the gentler sex. The gravest philosophers have dealt in them, and none, perhaps, so much as the Stagyrite himself. The English language, on account of the diverse character of its origin, which has crowded it with words nearly synonymous in meaning but widely different in expression, is peculiarly suitable to this form of begging the question. For a sophist can, if he chooses, bring forward a proposition expressed in words of Saxon origin, and pretend to prove it by giving utterance to the very same sentiment in language of Norman derivation, or *vice versâ*. This is the common mode of reasoning adopted by a peculiar class of political speakers. "The measure under consideration is the best fitted to meet the circumstances of the case (Saxon propos.); because it provides for all the exigencies that can be supposed to be involved in the question" (Nor. proof). "The bill before the House is calculated to elevate the character of the education of the

country (Nor. prop.); for it raises the general standard of instruction throughout all the schools[1]" (Sax. proof). So true is the saying of Hobbes, that words are the counters of wise men but the money of fools.

The reader must be on his guard against what Bentham termed "begging question appellatives," which assume the question under the guise of stating it. Thus, were a person to argue that because *liberal* institutions were beneficial to the country, that a Whig government ought to be preferred; he would assume the point in dispute by the use of the word liberal, the connexion of which term with such institutions being the very matter which requires proof. Instances of this kind of begging the question are presented in all discussions in which words of a laudatory or a vituperative character are used. For instance, the opponents of the recent establishment of the Roman Catholic hierarchy in these dominions, in all their arguments on the subject set out with the assumption of the act being an *aggression*, and thence proceeded to show it was a wanton outrage on the feelings of the country. Whether right or wrong, elaborate reasoning on the point might have been dispensed with, for the conclusion was palpably begged in the statement of the premiss.

§ 5.—*Ignoratio Elenchi.*

The concluding fallacy we have to advert to is called by Aristotle *ignoratio elenchi*[2], or ignorance of the contradictory of an opponent's assertion, which we fall into when, instead of proving the contradictory or *elenchus* of our adversary's proposition, we attempt to establish something else resembling it: but as it is substantially the same thing to prove what was not denied as to disprove what was not asserted, the fallacy may be employed for the apparent establishment of our own proposition as well as for the feigned refutation of that of an opponent's. Though the Stagyrite is as carefully minute in his description of this fallacy as of the last, his own reasonings will afford not the least striking specimens of its practice. Thus he assumes that Parmenides and Melissus admitted only a single principle of all things; as if they had understood by this principle that of which

[1] The phrases in question are selected from Hansard. Every parliamentary debate affords many choice specimens of similar inanities.
[2] De Soph. Elen. c. v.

ought to be shown, in order to warrant them to hold such an opinion, that the objections against the adoption of the thing are stronger and more numerous than those urged in its favour. This is the main fallacy of sceptics, who conclude that Christianity cannot be true as long as strong objections can be urged against any portion of the evidence on which it rests; and of bigoted anti-innovators, who oppose all reforms on the ground that no alteration can be proposed against which they cannot urge strong and unanswerable objections. But did such reasoning hold, and men choose to delay accepting any proposition until all the objections that could be brought against it were unequivocally disposed of, it is obvious that society could not advance a step in the way of speculative belief or of useful reforms.

An ordinary case of this fallacy is exhibited when we prove only a part of what is required, and dwell on that to the exclusion of the rest. Thus, if a man is charged with an offence, and some portion of the evidence adduced against him be of equivocal character, a skilful advocate will completely sink the sound part of the allegations, and expatiate on the others as if they constituted the only proof before the court. Hence in advancing more than can be well maintained, we expose the entire line of evidence to a complete overthrow; for a clever tactician will seize on the weak point introduced, and by dwelling upon that part of his adversary's argument, make it appear that it involves the whole question at issue, and resound his triumph over the field, as if he had demolished all the outworks of his opponent's position. No person, therefore, should lay down a principle without guarding or restricting it by modifications, since a clever antagonist is always sure to avail himself of his neglect in this particular, by pushing his principle over the boundaries of moderation. This course is frequently pursued in parliamentary rejoinders; and frequently afforded Canning a way to the citadel of his adversary, when reason and justice had fortified every other path against him. There is no principle, however just in theory, however reasonable in argument, or expedient in practice, which is not capable in its naked state of being carried to an extreme length, or represented in so ludicrous a light as to make it shiver in the hands of its nunciator as a weapon of reasoning. One of the most glaring examples of this kind of irrelevant

conclusion occurred in the debate on the institution of a commission of inquiry into the state of the universities. The principal opponent of the ministerial proposition took up the ground, that government had no right to inquire into the state of municipal or corporate bodies; a principle of which no one can dispute the justice so long as the movements of those societies do not interfere with the interests of the commonwealth, or impede the progress of the community;—matters, of course, over which the government have complete control. The defender of the universities, however, neglected so to restrict it, and the minister threw ridicule on his opponent by representing many cases in which a wise government could not abstain from interfering with corporate societies. The onus which lay on the minister, of proving that the universities presented a case for public interference was thus lost sight of, in the feelings excited by the confutation of the principle in the sense to which its propounder did not intend it to apply.

With the last form of *ignoratio elenchi* may be classed the common case of substituting a particular for a universal conclusion, or of proving something to be possible when it ought to have been proved highly probable; or probable when it ought to have been proved necessary; or contrary instead of contradictory; or improbable when it ought to have been proved impossible. Aristotle complains of this last branch of the fallacy as giving an undue advantage to the respondent[1]. Many a guilty person owes his acquittal to this; the jury considering that the evidence brought does not demonstrate the absolute impossibility of his innocence, notwithstanding the chances are innumerable against it.

This fallacy is not unfrequently combined with that of *petitio principii*, when the premiss implying the conclusion is assumed on the ground of something resembling it having been already established. An instance of this kind occurs in the speech of Cleon concerning the Mitylenians, who urges the *justice* of putting the revolters to death; which, as Diotodus, a subsequent speaker, remarked, was nothing at all to the purpose, since the Athenians were not sitting in *judgment*, but in *deliberation*, of which the proper end was expediency[2]. A similar illustration of the hybrid form of this fallacy may be seen in the objection urged against a scheme of national

[1] Rhet. b. ii. [2] Thucydides, quoted by Dr. Whately.

education; which assumes that the humbler classes, if properly instructed, would not submit to the low drudgery of their station, from the fact that those few at present who scrape together a little knowledge are apt to think themselves gentlemen and become discontented with their position. Now the force of the argument rests on the perfect similitude between the two cases, which is most gratuitously assumed. For when education is universal it must cease to be a distinction, which, as Archbishop Whately remarks, is most likely the very circumstance which renders such individuals too proud for their employment.

The combination of these two fallacies is very usual in parliamentary debates; and Canning's speeches afford several instances of their employment and detection. One of the most striking of the latter will be found in his reply to Mr. Perceval in the debate on Horner's resolutions, which emanated from the bullion committee of 1811. That statesman having referred to the continuance of our triumphs in the Peninsula and our conflicts with Napoleon as a reason for perpetuating an exclusive paper-currency, Mr. Canning replied: "I will not pay my right honourable friend so ill a compliment, as to suppose that he is not himself perfectly aware that in thus shaping his argument he has, in fact, rather assumed or omitted the question in dispute. The question is not whether we shall continue the war in the Peninsula with all our heart. Who doubts, who dissuades that determination? That point might have been assumed without hazard of contradiction. But my right honourable friend argues that point as if it were disputed, and assumes without argument that which was necessary for him to prove—viz., that to the continuance of the war and our successes in the Peninsula it is essential that the present system of currency should remain unchanged. Just as fairly might I assume without argument that a change in our currency is necessary to this same purpose of continuing the war, and then retort upon my right honourable friend his own expostulations against fettering the energies and cramping the exertions of the country. In either case the point which is alone in dispute remains to be decided."

APPENDIX.

MODERN SCHOOLS OF LOGIC.

A DISTINCTION is sometimes sought to be erected between the different modern schools of logic, as if the predominant elements in each contained something necessarily antagonistic to one another. Thus we find the verbal school of logicians including men whose views differ so widely as Hobbes, Dr. Whately, and the schoolmen set up in antagonism to the sensational or phenomenal school, which numbers Bacon, Helvetius, Comte, and Mill among its chief expositors; and these again contrasted by way of opposition with the conceptualist school of logic, of which Kant is the chief exponent[1]. The student having been introduced to these different varieties of logical sects, is told that he can make only one choice, and that the set of tenets which is pointed out for his acceptance must necessarily place him in antagonism with the opposite schools.

It must not, however, be overlooked, as the functions of words, conceptions, and things, are conjointly admitted in every rational system of logic, that there is no necessary antagonism between these separate elements in logic, further, indeed, than what may arise from the importance of any one being so unduly exaggerated as to exclude or unduly interfere with the functions of the others, in the inferential process. Each school, with the exception of one or two extreme sections, admit that words are only the embodiments of the mind's conceptions, while the latter are only so many ways of regarding external phenomena, so that there is in reality

[1] Essay on Logical Method, by Charles P. Chretien, ch. v. p. 94. Oxford. 1848.

nothing to prevent the main body of their individual opinions from being collected into one system of logic, and thus to exclude that sectarianism in this department of philosophy which is the disgrace of religion. What is there in Mill beyond his nominalist views which interferes with Kant's logical doctrines as propounded by Jahsche? or in Whately's exposition of the scholastic logic, which conflicts with either, unless matters of metaphysical concernment, which have no claims to be acknowledged in logic, as the ground of antagonistic schools? Mill's nominalist views would certainly, if carried out to their extreme consequences, upset the scholastic theory of logic, but as a proof that he did not consider his purely logical opinions at all conflicting with those put forth by that school, he refers his readers to Dr. Whately's treatise, as containing views in a great measure supplementary to his own. In eliminating, therefore, in the foregoing treatise, the conflicting metaphysical opinions of the different schools of logical writers, we have found nothing in the body of their logical doctrines which refused to combine harmoniously in one system.

In referring, however, to the extreme sections of some of these schools, we might find matter to legitimate an opposition of logical doctrines; but this, so far from leading to the distinction upon which we have animadverted, would really take it to pieces. Thus the extreme exponents of the verbal school are Hobbes and Condillac, who, denying altogether the antithesis between thought and language, assert the identity of each, and make every question purely verbal. With Hobbes, logic is only a peculiar kind of mental arithmetic: "Reason is nothing but reckoning (that is, adding and subtracting) of the consequences of general names agreed upon for the marking and signifying of our thoughts. Logicians," he further says, "add together two names to make an affirmative, and two affirmatives to make a syllogism, and many syllogisms to make a demonstration, and from the sum or conclusion of a syllogism they subtract one proposition to find the other[1]." Condillac, though in other terms, expresses precisely the same doctrines[2]. With him reasoning is only a kind of algebraical computation, and

[1] Leviathan, ch. v. [2] Hist. Introd. p. 19.

definition the only weapon in the logical armoury; and the greatest results to which the most successful scientific researches can lead is a well-assorted language: "Science, c'est une langue bien faite." There is nothing, however, in these views, even so far as verbal logic is concerned, to place them in the same category with those entertained by Whately and the scholastic logicians. While the scholastics, and their modern representatives, overstrained at one time the conceptual and rational faculties, and at another placed too much reliance on the powers of language to explain fundamental differences of principle[1], they nevertheless admitted the reality of external phenomena and the correlative functions of language and conception in the elaboration of thought. Hobbes and Condillac, on the other hand, denied as rigidly the distinction between mind and matter, and implied that reason was a consequence of our bodily organisation, and depended on speech for its existence. They consequently belong to that group of logicians who, with Locke and Dugald Stewart, ignore the functions of the school logic as far as propositions and syllogisms are concerned, and as such stand in direct opposition to that school of logicians with whom they are sometimes classed.

There is, notwithstanding, among the general body of logicians who admit the syllogistic theory with proper limitations, a tendency to give undue expansion to one element in the triad to which we have alluded; the *à priori* school, placing too much stress either on words or on conceptions, while the nominalist branch are too apt to degrade the former and place external phenomena in the ascendant. Thus it cannot be denied that one of the chief defects of Whately's exposition of the Aristotelian logic is the attempt to seek for the origin of every dispute in verbal equivocation[2], and to measure the powers of thought by the verbal

[1] Horne Tooke, who took Shakspeare's expression that "the lip is parcel of the mind" (Merry Wives of Windsor, act i. sc. iv.) as a great philosophical axiom, refused to admit there was anything simple or complex, general or abstract, in ideas apart from the terms themselves. (Div. of Purley, p. i. ch. ii.) These views have been advocated by French and the leading High Church divines, and were cherished by De Maistre. (See his criticism on Bacon, art. Syllogism, in the collection of his posthumous works.) [2] Thus he resolves the dispute on Arianism and Sabellianism, which for nearly two centu-

conventionalisms by which men choose to invest its mysterious processes with external embodiment. Thus in treating of hypothetical and inductive arguments, he compels methods of reasoning which when viewed in the thinking mind are clearly distinct from the deductive process and from each other to bow to an artifice of language and submit to the unvarying formula of the deductive syllogism. His manifest aim is to underrate the number of real questions at issue among mankind, and to increase in proportion the number of verbal differences. In dealing with contending disputants he either accuses them of an equivocation, *i. e.* that they mean the same thing by different words, or use the same word to signify distinct things—or he looks for some formal error in the argument of one of the parties, to which he assigns the discrepancy, rather than refer the cause to some broad difference of principle underlying the whole discussion[1]. In a similar spirit it is the tendency of conceptional writers to confound logic with metaphysics[2], and to make both language and external realities submit themselves to the domineering influence of mental theories.

Mr. Mill's "System of Logic," on the other hand, may be taken as an instance of the undue preponderance given to external phenomena, and the subjugation of language and conception to physics. The favourite notions of logic are transferred from the inner to the outer world: sequence causation with abstract and general terms are held to be derived from phenomena, and not to be the conditions of the mind's perceiving them. Logic, in this view, is represented

ries divided the opinions of some of the leading minds of Christendom, into a mere play upon the words *one* and *same*. We need hardly say that there is no difference of opinion, however fundamental, which could not be explained away in like manner. Thus the dispute between the Spinozists and the Christians, with respect to the existence of God, might be resolved into a mere verbal shuffling upon the word Deity. Both classes of disputants really admit the same power existing from eternity, and endued with creative energies—the only difference being that one call it Nature, and the other God; but what is there in a mere nominal discrepancy to keep the Spinozists and the Christians apart so long as they imply in substance the same thing? [1] Chretien, Log. Meth. p. 101. [2] As is observed in the title of Mr. Thomson's Logic, viz., Laws of Thought. Logic, however, has nothing to do with laws of thought further than these are involved in the process of inference.

not as dealing with conceptions, but as employed directly about things. In like manner, words are considered as signs rather of things than of our conception of them[1]; and propositions are treated not as connecting two ideas or conceptions, but two things. The mind is thus thrown on the outward world for the conditions of its laws, and is deprived of the dignity of independent action, which its superior nature would lead us to think was its natural prerogative.

There is, however, no conflicting opposition between the main body of the strict logical doctrines of these several schools, but only in the exaggerated expansion they are apt to receive from the hands of zealous partisans.

[1] Vol. i. p. 28.

APPENDIX TO BOOK I.

Chapter II. §§ 1, 2.

Nominalism and Realism.

A few lines of Porphyry on the predicables of Aristotle, raising the question long before agitated between the Stagyrite and Plato, as to whether universal conceptions or general ideas which include classes have any existence out of the human mind, gave rise to the angry disputes concerning nominalism and realism which disturbed the repose of Christendom from the eleventh to the fifteenth century, and which had previously evoked the same stormy discussions among the doctors of Islam. The question both in the Mussulman and Christian camp had assumed a more complicated form from being involved in theological quarrels; and as long as the most vital dogmas of religion were thought to depend on the issue, the fire of spiritual zeal invested these debates, which almost cotemporaneously excited the passions of two hemispheres, with an interest to which the most absorbing discussions of the present epoch can furnish no parallel, and which were frequently silenced, but never suppressed, by the mandates of the civil, and the anathemas of the spiritual, authorities.

Now, when all the smoke has been cleared away, and the question has been again presented free from any adventitious element, it does not appear to have derived much elucidation from the searching investigation of so many learned doctors, though the inquiry, if we take the Mussulman abbas into account, extended over a period of six centuries. These gentlemen, after a fearful waste of time and zeal, left the question just where they found it, with the exception of Avicenna, who is said to have started the doubtful theory of conceptualism, which Abelard and Occham had the poor merit of transplanting into the Christian arena of the dispute. This theory, however, though not directly broached by Aristotle, would evidently impress itself on any reader of the pre-

dicables as the very solution of the difficulty which the Stagyrite had embraced: its formal originators have, therefore, little claim to novelty, except, indeed, for the improper use to which they applied it, in accounting not only for the mode in which class notions or general ideas enter into the mind, but also in confounding this with their absolute existence—a point which Aristotle very properly left undecided.

With regard, indeed, to the mode in which the mind acquires universals or class ideas, philosophers are generally united in assigning the process of abstraction which we have attempted to explain in the text. In every object there is always some property analogous to others in surrounding objects, which compel us, as it were, to generalise in a particular way. Thus we place houses in one class and men in another; nor are there any people so uncultured as to rank some houses and some men in one category because they are red, or to confound tastes and sounds together because, in many cases, they are accompanied with agreeable sensations. In like manner, the mind traces among classes of phenomena similar organisations and properties within them, and, having formed conceptions out of these classes, always applies the name wherever it meets with an individual instance of the general property. Such designations have generally led to the classifications we meet with in zoology and botany, where animals and plants are ranged into classes to bring out in bold relief the most striking differences of their organisation; and according as such conceptions in the mind are founded upon the real properties of external objects, and classified according to their importance in creation, are they to be relied upon as correct representations of class properties in nature. Now if creation had a spiritual designer, it is impossible to resist the conclusion that, before He evolved the world out of chaos, such class properties existed in His mind as archetypes or moulds after which the fabric of existing things was fashioned to which they correspond. If the same vertebral column is found in a hundred species of animals, occasionally joined to large powerful limbs, and sometimes to small rudimental ones, we are compelled upon the Christian hypothesis of creation to infer that this part of the frame was pre-ordained to be the connecting link of these species, and that in forming a class of vertebrate animals, we are seeking

after a form or idea which existed in the divine mind when animals were created. Universals or class ideas, therefore, may be said in this view to exist without the mind of man, in as far as they are in another mind. The divine mind stamps them on material things; the human mind reads them there.

The controversy is thus resolved into questions which are extrinsic to pure philosophy, and would, perhaps, never have arisen, had not natural theology been confounded with it. Plato, through his love of system-making, would explain everything, and regarding nature as a sealed book, he taught his followers that they might easily put themselves in possession of all the truths it contained by *à priori* speculations on the divine mind, in which the original designs existed upon which nature had been modelled. This, though to a certain extent true as regards morals and æsthetics, was absurd as regarded the material creation; and Aristotle very naturally challenged the whole doctrine as an assumption in the department of philosophy; being an attempt to explain what was certain by what was mystical and obscure. How do these ideas, asked the Stagyrite, exist in the divine mind? Whether as an attribute or a substance; and if the latter, as the Platonists maintained, how can the universal exist in the singular? Again, Roscelin and the scholastic nominalists required to know if such ideas existed in the divine mind from eternity, or were subsequently evolved out of it by an after process of thought? If the first case, other substances existed from eternity besides God, which is inconsistent with the divine existence as a necessary being; if the latter, the attribute of his immutability was set aside. Again, must there be an idea for every sensible object? If so, before Socrates could be born there must have been an eternal idea of Socrates; which would lead to a multiplication of ideas too great even for the imagination to grasp. Then there arose the multifarious questions concerning the mode by which they entered into the mind, and how they became connected with the things to which they belonged. To say that the things participate in, or are copies of the ideas to which they correspond, was, the nominalists alleged, to avoid the difficulty by vague metaphorical language. In this manner it was by no means difficult to show that the Platonist realism jarred with its own hypothesis, through the exaggerated view which it took

of a principle having its foundation in truth. Aristotle confronted Plato's doctrine, because it closed the era of physical inquiry; and the scholastic nominalists, because it clashed with the plainest facts of our own consciousness, with regard to the mode by which we come into possession of class conceptions.

The nominalists, however, erred by the tendency they manifested to push the doctrine concerning class conceptions to the other extreme, in asserting that these universals were mere names, and were not only unconnected with any class properties in nature, but had not even a mental conception to support them. But unless general names can be assumed at will, it must be admitted that they are inseparably attached to the general qualities which they connote. Between the individual object and the general name, we must insert the notions for which the name stands; as between Socrates and the name "man" there intervenes the mental notion of the properties which make man. Nominalism thus, in its strict sense, is indefensible; and those who held it deserve the censures which were heaped upon them as the virtual destroyers of philosophy. Their theory tends to represent the operation of thought as purely mechanical, and to invert the obvious facts of the case by making reason a function of language, instead of viewing language as a consequence of reasoning.

To escape the absurdities of the ultra-nominalist theory, Abelard, and subsequently Occham, alleged that general names signify general notions dependent on the abstracting powers of the mind, but though independent of single objects, without any real substantial entity corresponding to them in nature. They made no distinctions between moral and physical notions, or attempted to explain how we obtain the general ideas of goodness, virtue, and beauty from the faint exemplars of surrounding objects; nor did they attempt to reconcile their theory with the existence of the divine mind, or the Christian hypothesis of creation. This theory of universals, which is called conceptualism, is, therefore, open to grave objections. Even so far as the mode is concerned by which the mind comes into possession of general notions, it only accounts for those which are derived from physical creation; while, if followed out to its extreme consequences, it would strip that creation of an intelligent artificer.

In rejecting, however, the nominalist view of universals, both in its ultra and moderate conceptualist aspect, we do not venture to recommend the acceptance even of a modified view of the realist doctrine, on the ground that the class ideas which the mind abstracts from physical objects must, in the present state of science, be correct representations either of the primary ideas in the divine mind, or of their correlative properties in nature. The process by which the mind seeks to attain these universals often leads to erroneous results; and even when we attempt to arrange them in subordination to each other, in few cases can we positively assert that the arrangement is a correct expression of their gradation in nature. Viewed as a statement of abstract truth, if the zoological system of Linnæus was right, that of Cuvier is wrong. Only when we are assured on the best evidence that we have attained to the real nature of things, and understand their relative positions in the scale of creation, can we rely on the validity of our class terms as correct exponents of natural universals[1]. Until we are certain that our class conceptions have reached this point of accuracy, they will only stand as symbols of a provisional classification, which greater research, or more skilful analogies, may at any moment supersede.

In summing up this important controversy, we may take, as far as regards morals and æsthetics, the Platonic theory of universals to be in the main correct; while in relation to physical truths we must accept such universals as purely conceptual which simply correspond to artificial systems of nomenclature; as, for instance, the Linnæan system of botany; or those of whose correspondence to the actual order of things in the external world we have no direct certainty. With respect to those general conceptions which may be fairly relied upon as correct exponents of outward realities, they may be regarded in the Platonic sense as copies of the designs existing in the divine mind at the period of creation; while the conceptualist view must be adopted with reference to their origin in the human mind from an analysis of things. The ultra-nominalist account of universals we discard altogether, and place the correct theory in a combination of Abelard's views with Platonic realism.

[1] Chretien, Logical Method, p. 76.

Chapter II. § 6.

The Categories of Aristotle.

These categories have been cited in the text as an example of correct division, and also as an appendage to that part of the Aristotelian logic which refers to the hunting out of genera and proximate species in the process of definition. They are, however, in a practical system of logic of no real value, and were very properly banished by Arnauld to metaphysics.

Some dispute has arisen whether the categories referred to things, to words, or to conceptions; and, according as they have been deemed a division of one of these three subjects, they have been exposed to much criticism. Chretien asserts[1], that the ten predicaments are purely "an analysis of the leading parts of speech and certain modifications of them," and endeavours to point out the mode in which they might have been obtained by any philosophical grammarian. As such he allows the correctness of the division, but questions their utility beyond the specimen they afford of subtile analysis. Kant, on the other hand, accepts the predicaments in an exclusive sense as a division of the conceptions which dwell in the pure understanding; and endeavoured to make it more complete by the addition of post-predicaments, or five supplementary categories. It was not difficult, in this erroneous view of the case, to cavil with the Aristotelian division as blending empirical and deduced conceptions—viz., motion, action, and passion, with primary notions; and also to show, by extending the term conception to mere subjective conditions of thought, that there were many such conceptions not even implied in the predicaments of the Stagyrite. Kant, on these grounds, subsequently substituted for the old list of predicaments and post-predicaments a new division of categories—viz., Unity, Plurality, Totality, Affirmation, Negation, Limitation, Independence, Dependence, Inter-dependence, Actuality, Possibility, and Necessity,—which he defined as the "subjective conditions of thinking, or the rules which the understanding,

[1] Logical Method, p. 119.

foregoing all the given diversity of consciousness, lays at the foundation of nature by means of its own essential laws."

The predicaments of Aristotle have again been accused of incorrectness, on the ground of being strictly a division of things. In this light Mill fairly shows that they are open to a charge of cross-division, quality, and relation for instance, running into each other in the case of habit, and position falling under relation as a species under a genus. Mr. Mill then proceeds to state his own categories of all nameable things in the following order: 1st. Feelings, or states of consciousness; 2nd. Minds which experience these feelings; 3rd. Bodies or external objects which excite certain classes of these feelings, together with the powers or properties whereby they excite them; and 4th. The successions and co-existences, the likenesses and unlikenesses between feelings and states of consciousness.

Aristotle's categories, however, are not to be judged exclusively on any of the grounds above enumerated, being intended, as Mr. Mill indeed admits, as an enumeration of the most extensive conceptions, or *summa genera,* into which all things capable of being named can be distributed. They are not names of things, or of words, or of conceptions apart from each other, but simply a division of things into the most extensive conceptions that the mind is capable of distributing them, and as such correspond, of course, to the natural divisions of language which is framed on the model of those conceptions. Kant's view of the Aristotelian categories was, therefore, entirely a mistaken one. Mr. Mill, notwithstanding his correctness with respect to the point of view in which the predicaments are to be considered, is, we think, in error as respects the superiority of his own categories in a logical system. Waiving the objection that it confines spiritual existence to human minds, and, therefore, does not seem exhaustive, the generalisations which it involves cannot be assumed, on Mr. Mill's own principles, to be correct, till inductive science has worked its way up to the boundaries of knowledge and thrown aside the curtain which hides the universal frame of things. In a word, as logical it is out of place; as a correct distribution of nameable things, even shutting out the spiritual world, its correctness and usefulness are only conjectural.

Of the list of categories already given to the world, the peripatetic is the only one which aims at taking a distinct place in logical science; and so far, indeed, as the scholastic conception of this science is concerned, it will be found to answer the requirements of its framer. Being devised at a period when nothing beyond language was very philosophically elaborated, it may be faulty in giving too great a preponderance to the verbal element; but we must not lose sight of the fact, that considering the narrowness of the human faculties, no division of this kind, which aims at the distribution of every nameable thing under the highest heads in which they are conceived by divine intelligence, can possibly be devised without being open to many objections. Aristotle's attempt, to say the least of it, is the most perfect that has been made. All the others seem to be quite independent of logic, being conceived more or less in reference to the metaphysical system adopted by their framers. The Pythagorian, Platonic, and Stoic schools among the Greeks, had each its corresponding tables. And in modern times the word has come to denote the distinctive classification of each metaphysician, whatsoever his system leads him to discuss, or howsoever he divides it. Thus, Reid tells us that the categories of Locke are three—Substance, Modes, and Relations; and those of Hume two—Ideas and Impressions; and, he adds, amusingly enough, that an excellent mathematician of his day desired to substitute for the peripatetic predicaments two only—viz., *Data* and *Quæsita.*

Chapter IV. § 1.

Use of Language in Logic.

Some confusion has originated in former treatises from the absence of a distinct conception with regard to the relation of language to thought in logic. Dr. Whately, for example, has defined logic as the art of employing language properly for the purposes of reasoning, and thus implied, either that thought and language are invariably united, or that the mere words, by which the results and the process of inference are expressed, form the substantial element about

which the science is employed. The latter is to mistake the shadow for the substance; the former involves a false metaphysical hypothesis.

Even taking the high ground of the Scripture theory in its literal sense with regard to the origin of language[1], it implies no more than that man was endowed with the power of framing words to correspond to his conceptions: as such it dissevers thought and language, and allows the latter no other value than as its vehicle and exponent. There is, however, a wide school, principally consisting of High Church divines, who believe that words are something more than mere signs—who stoutly contend that they are vital powers, and seem inclined to reverse the ingenious remark of Hobbes, that words are the counters of wise men, but the money of fools[2]. We have, notwithstanding the crowd of assertions in favour of this view, met with nothing like a single reason in its favour. That words may be employed as strong impulsive forces may be easily admitted by any one who has observed the power which the skilful rhetorician exercises over the crowd, or the influence of language in the advancement or deterioration of society; but that words derive this power from any other source than their symbolical character, no one can maintain with even the semblance of argument. If words are used as the signs of things and conceptions, it is very natural they should, as Bacon alleges[3], react upon the intellect, and limit and, in some measure, control its operations; but from this surely nothing can be inferred except the liability with certain minds, from the constant association of language with thought, to mistake words for realities, and believe that they command language, when in reality language commands them.

[1] Gen. ii. 19. [2] Trench expressly does so, and goes out of his way to call the Malmesbury philosopher "one of England's false prophets." Study of Words, p. 25, 3rd ed. "There is a sense of reality about children which makes them rejoice to find there is a reality about words." Ibid. Their reality, however, is derivative, and not primary. There is nothing in Trench's valuable treatise which really conflicts with Hobbes's views, unless his uncharitable expression and the reversal of Hobbes's brilliant aphorism. [3] "Credunt enim homines rationem suam verbis imperare. Sed fit etiam ut verba vim suam super intellectum retorqueant et reflectant."

Words being simply instrumental in aiding the mind to travel much further by means of general terms than it could without their aid, can only be considered in logic so far as their employment either tends to assist or to defeat the process of inference; and, as with instruments of another kind, our care should be that they faithfully transmit the properties they were intended to convey, and not "palter with us in a double sense," or be allowed to float about either with a loose, unsettled, or inaccurate connotation.

Chapter IV. § 2.

Abuse of General Terms.

As an instance of the disputes to which the employment of general terms may give rise in fundamental questions of law or government, Trench adduces the Latin word *Beneficium*. This word, it appears, anciently implied either benefit or benefice, either we suppose on account of the advantages that accrued to the minister from the possession of the revenues, or the benefits that were believed to flow to the people from his pastoral functions; and is used in both senses by Wicliff in his translation of the Bible (1 Tim. vi. 2). As the term, however, was early connected with the conflicting claims of imperial and priestly jurisdiction, it was not long before its bifold signification was turned to account. Pope Adrian IV., writing to the Emperor Frederic I. against certain lay encroachments on the spiritual authority, reminded the Emperor "that he had placed the imperial crown upon his head, and would willingly have conferred even greater *Beneficia* upon him than this." Had the word been accepted without a remonstrance, it might have been afterwards appealed to as an admission on the part of Frederic that he held the empire as a feud or fief (for *beneficium* was then the technical word for this, though the meaning has been much narrowed since) from the Pope—the very point in dispute between them. The word, however, was repelled by the Emperor, whereupon the Pope appealed to the etymology,

that *Beneficium* was but *bonum factum*, and protested that he meant no more than to remind the Emperor of the "benefits" which he had done him, and which he would have willingly multiplied still more[1].

CHAPTER IV. § 3.

Transitive Application of Words.

The transformation of words from one distinct sense to another, without either widening or diminishing their application, may be taken as one of the most general laws of language. A striking example of it may be adduced in the application of the term "classics" to denote, according as the object either refers to languages or books, those of the highest excellence. Thus, when we speak of the classical languages, we refer exclusively to the Greek and Latin, because these tongues have been always considered by Europeans as exemplars after which they might improve their own. In like manner we refer to the works of Milton or Dryden, Racine or Boileau, as English and French classics, the productions of these authors being ranked as the best of their kind by the general body of their countrymen. The word "classics," or *classici*, however, was attended at first with a very different signification. This word was originally applied by the political economists of Rome to designate men who possessed the largest income—Roman society being divided into classes according to the amount of property its respective members possessed, with a view that each might be rated in proportion to his ability to contribute towards the expenses of the state. The individuals in the foremost rank were called *classici*, in contradistinction to men of the second, third, or fourth class, who are termed *infra classem*. When the Roman political system was broken up, and the term wandered about without a meaning, it was associated by an obvious analogy with the works of the ancient writers; since, at the time when the appellation was bestowed, no works were written either in the East or the West except in Greek and Latin, and it could

[1] We have not verified the accuracy of this statement, but give it on Trench's authority, and almost in his own words. Study of Words, p. 157, 3rd ed.

not be considered that the mediæval writers were able to rival the Pagans in the use of their own tongue. By degrees, however, as the barbarous dialects of Europe took "the form and pressure" of the ancient languages, and men felt sufficient confidence in their stability to make them the vehicle of their literary bequests to posterity, the term classics made another leap, and is now applied in conjunction with its mediæval signification to designate the best writers in any of the modern languages.

As an instance of the disputes to which the transitive application of words occasionally give rise, we may cite the history of the word *sacramentum.* This word is first met with in the Roman law as signifying a deposit or pledge, which in certain suits defendant and plaintiff were alike obliged to risk upon the condition that the loser of the action should forfeit his, to the nearest temple. Hence the name *sacramentum* or consecrated thing was applied to the property thus offered as a guarantee of sincerity. We next find the word used in connexion with the military oath by which the soldiers of the Republic bound themselves never to desert their standards, or turn their back upon the enemy. From being applied to denote the sacredness which the Romans attached to their military engagements, it soon became synonymous with any oath whatever.

The early Christian writers in appropriating all the terms of a solemn or sacred character in the heathen vocabulary, and applying them to the nascent theology, were not always careful to avoid a bifold meaning. As something peculiarly sacred was attached by the ancients to the solemnity of an oath, the first Christians applied the word sacrament to designate in particular a class of actions which were also deemed of peculiar sanctity in their system, and in return for which divine grace was communicated to the soul by certain ordained ceremonies; and solemn engagements were entered into by the recipients to continue true to the fulfilment of certain duties. But the early Christian writers also applied the word *sacramentum* in a loose, secondary, or analogous sense to denote any sacred transaction that had some special solemnity or sanctity attached to it; as the incarnation, the lifting up of the brazen serpent, the giving of the manna; which in time led the two senses to become confounded.

Hence the controversy has arisen, how many sacraments the early Church acknowledged of divine institution. The Catholic stoutly maintains there are seven, while the Lutheran will only admit two, explaining away the passages cited against him from the early fathers which call matrimony, extreme unction or confirmation sacraments, as so many uses of the word in its second signification[1].

Chapter IV. § 4.

Twofold Law of the Transformation of Names.

A crowd of examples might be produced from French or any similar treatise in illustration of this law; nor is the observance of the course which words take in obedience to it without historical or even moral significance. Thus, with regard to the specialisation of words of general meanings to denote some peculiar object or function, we could not form a very favourable idea of Roman chastity at the time when *Conciliatrix* was employed to designate a female pander; or of French and English manners from the particular application of the word "esteem" in the reigns of Louis XIV. and the second Charles. More favourable instances of specialisation may be noticed in our day in the use of the word "irregular" to characterise a person of profligate manners, or of "the acceptance of a consideration" to signify the receipt of a salary. This tendency to denote things by words which convey the faintest impression of their disagreeable properties is not confined to the refined classes of society, but is occasionally apparent among the commonalty, as in the application of the word "love-child" to designate illegitimate

[1] Trench defends the latter view on the ground of its adaptation to the old Roman signification. "The remembrance of the use of sacrament to signify the plighted troth of the Roman soldier to his *imperator*, was that I think which specially wrought to the adaptation of the word to baptism; wherein we also, with a manifest allusion to this oath of theirs, pledge ourselves to fight manfully under Christ's banner, and to continue his faithful soldiers and servants to the end." But Trench forgets that by a similar parity of reasoning confirmation ought to be placed in the same category.

children, or the word "tally" to a female living with a man out of matrimony[1].

Instances of the contrary law of generalisation are still more common. The word bigot (bigote), for example, from being in the Spanish language the name for moustache, which in that country was deemed a mark of resolution and firmness[2], came to be employed in this country as a by-name for Roman Catholic, and on account of the unhappy notoriety of Spain in religious persecution, the term was afterwards extended indiscriminately to all those who exhibited any symptoms of exclusiveness or of a persecuting spirit in matters of religion. In like manner the term rivals was originally confined to those who dwelt on the opposite banks of the same river, from the disputes which they had at different periods concerning their right to turn off the stream into their own fields, or keep the sluices open as it suited their convenience. From this the term was gradually extended to conflicting claimants of every kind, and finally included all persons engaged in unfriendly competition with each other.

Chapter IV.

Primary and Secondary Intentions. Analogical use of Terms.

The first intention of a term is a certain vague and general signification of it in contradistinction to one more precise and limited which it bears in some particular art or science, that is called its second intention. Thus a "line" expresses a certain idea of extension which constitutes its primary signification, and which nearly corresponds with the employment of the term in mathematics; while in military art it signifies a certain form of drawing up ships and troops; in geography a certain division of the earth; in angling a string to catch fish. These, therefore, constitute its secondary intention, the term in each being employed not in its broad, naked sig-

1 Extreme instances of the law of specialisation generally go under the name of Euphemism. 2 *Hombre de bigote* is the Spanish for a man of resolution, and *tener bigotes*, in the same tongue, means to stand firm.

nification, but expressing something foreign in addition, according to the purposes for which it is employed.

Occasionally words are turned from their primary signification and used in an analogical sense, as we talk about "weighing reasons," or when we attribute the sense of sweetness to sounds; nor can error arise from this employment of terms so long as we do not take the analogy for more than it is worth, or imagine that things must be similar in themselves because they have similar relations to each other. But this error, as we have seen in the word sacrament, will sometimes happen; men confounding the primary with the analogical meaning of the term, and deeming the one signification in many cases of no more importance than the other. The same destiny has attended the word servant. Because this word was applied to persons under the Jewish law whose lives and property were completely at the mercy of their masters, some persons in our day seem inclined, from the old word being still in use, to exact the same peremptory service from those who serve them, as if the ancient duty of slaves still attached to persons in an analogous position. In a similar manner, because we can hardly speak of the operations of the spirit without employing the terms which are commonly used to express analogous physical action, it has been alleged that no such thing as spiritual substance exists, and that thought must be an attribute of matter; or, in other words, because mind and body have similarity of relation they must be identical.

There are two more classes of words which are apt to introduce confusion, as far as an accurate rendering of thought is concerned: viz., those which under one name apply to several distinct things; and others vulgarly called synonymes, which, while differing slightly from each other, are associated with one meaning. As an example of the first kind, we may take the word "stock," which from being anciently the past participle of "to stick," came to designate everything into which the idea of "fixedness" entered in a definite manner. Thus we have live-"stock," the stock of a gun, stock in trade; the "stock"-dove, the stock which goes round the neck, the family stock, the village stocks, the stocks in the public funds, the stocks on which ships are built, and an infinity of other stocks of an analogous kind. In like manner we find

the word "post" from the Latin *positus*, that which is "placed," applying to a variety of objects into which the idea of that participle enters: as a military station, an office for letters, a piece of timber placed in the ground, and an official position. The same term is also used in a verbal sense, as to "post" a ledger, and also adverbially, as to travel "post," "post"-haste, &c. The same variety of meanings occurs with the word "case," and hundreds of other terms in the English language.

When the difference of meaning between the several significations of one word is not clear, great confusion is likely to arise from their use. Thus, when we say the "rose smells sweet," "I smell the rose," the term "smell" refers to two objects widely different. In the first sentence we speak of a quality in the flower; in the second, of a certain sensation in our minds. On this ambiguity have been founded the striking paradoxes of those who maintain there is no heat in fire, and no cold in ice. In the same manner the term "certain," as used with reference to the state of the speaker's mind, as "I am certain of the fact," or to denote the accuracy of any intelligence, points to two different objects; and philosophers have not been wanting to avail themselves of such equivocation to deny the existence of certainty altogether.

In guarding against similar ambiguities of speech, all languages are not equally fortunate. The Greek and the German are much more philosophically accurate than the Latin; and the Latin in this respect may be said to surpass the French, Italian, and Spanish, while our own language is behind each of the latter triad in the same quality, however much it may surpass them in strength and copiousness of diction. Thus, the German takes care in using the same word in different senses to make some change in the spelling, or in the gender of the term, or in his mode of forming the plural, that the meaning may be distinguished. In this manner, we find *der Band* to signify a book, *die Bände* books; *das Band* a tie and ribbon, *die Bande* ties, and *die Bänder* ribbons. In like manner *die Worte* signify spoken words, and *die Wörter* written words; *die Strausen* mean ostriches, *die Sträuse* bouquets of flowers. A similar arrangement occurs in Italian to distinguish the primary and analogical meaning of words. Thus, *le fondamenta* means the founda-

tions of a house, or material edifice, but when applied to the first elements of an art or science *i fondamenti* must be used. In like manner we have *le membra* to denote the members of the human body, and *i membri* the members of society, or of any other social corporation. The same distinction may be traced between the words *le frutta* and *i frutti, le corna* and *i corni*, and many others. The same subtilty of distinction is manifest in the employment of the Spanish and Italian pronoun, which entirely excludes the possibility of those mistakes which sometimes occur in the English use of the same article of speech.

In German and Greek a systematic order of distinction is observed to make words correspond by a little alteration, generally on the final syllable, with all the shades of difference in which they can present themselves to the subject mind. Accordingly we find a distinction preserved in the two languages between the same term used in the concrete and in the abstract, and also between the result of an act and the act itself, so that it would require a person to be in some respects a philosopher to understand their simplest conventionalities. Thus we find in the Greek τεχνη, the abstract term for art; but τέχναι, the concrete name for the exercise of any particular art; and in German *That*, an action or deed; Thatigkeit, or activeness; so Kenntschaft and Kenntniss. In like manner πρασις, the doing of anything, πραγμα, the thing done; so δοσις and δωρον, ληψις and λημμα, &c. In English, however, there is no similar arrangement, and we are frequently obliged to use the same word in different senses. Thus, "learning" may either mean the act of acquiring knowledge, or knowledge itself; "shot," the materials of ramming a gun, or the act of firing it, and so with others.

Confusion is also apt to rise from the opposite practice of using many words to express the same sense, especially when such terms are on the eve of being desynonymised, or when the shade of distinction that begins to obtain among them is far from being universally acknowledged. The English language is, perhaps, more open to confusion of this kind from the various elements of foreign words which have become amalgamated with it in the course of history, and which have given it many names for the same thing. Thus from Norman Latin and Greek sources, in addition to our native

Saxon, we have shepherd and pastor, feeling and sentiment, handbook and manual, love and charity, freedom and liberty, numeration and arithmetic, supposition, theory, and hypothesis, almighty and omnipotent, unreadable and illegible, reason and understanding, fancy and imagination, poetry and poesy, burdensome and onerous, keenness and subtlety; and so with duplicate verbs: to heal and to cure, to whiten and to blanch, to soften and to mollify, to cloak and to palliate, and many others. Now, notwithstanding each of these duplicates, words were used originally in the same sense, they have now separated from one another, and acquired separate meanings to answer the varieties of fresh thoughts and feelings which society acquires in advancing to a high state of civilisation. Hence, as this desynonymising process is constantly going on, mistakes are apt to arise from the use of words in a sense exactly equivalent, when a broad distinction is acknowledged between them[1].

[1] See Coleridge, Biog. Lit. v. i. p. 90, and Lit. Rem. v. i. p. 219, and v. ii. p. 365, and Table-talk, p. 140, and Trench, Study of Words, Lect. v. p. 142, from whom these quotations are taken.

APPENDIX TO BOOK IV.

CHAPTER I. § 1.

Analysis and Synthesis.

WHAT we have advanced on analysis and synthesis in the text mainly refers to the applied sciences, where it is usual when the tentative process of analysis is complete, to construct the synthesis by way of verification, and also to employ the latter method of statement in teaching as more scientific and complete. Analysis, however, is not always thus subordinate to synthesis, as may be shown by any simple instance from the analytical mathematics. In a common algebraical equation one or more unknown quantities are given, and the consequences are traced backward till those quantities become known. It is not considered necessary to show, by reversing the process, that the results obtained actually fulfil the conditions which the unknown quantities were assumed to fulfil in the original formula.

Another instance in which analysis is perfect without any corresponding synthesis is found in the ordinary process of deliberation, which has sometimes gained, in consequence, the name of practical analysis. Those who deliberately desire any object which they have reason to suppose within their reach, begin by assuming it is attainable by them, and then proceed to consider on what antecedent conditions the attainment of the object depends, and to what conditions these in turn are subject. Thus they continue precisely as in mathematical analysis, until they arrive at certain elementary conditions, which their own consciousness tells them are within their power—certain acts of their individual will, and the natural expression of it in word or deed. The analysis is perfect when the agent can clearly perceive that all the actions or means on which the result depends are fully within his power, and when he is conscious of the force of his own will to bear him through them. The analytical process is complete in itself, because the subsequent actions which correspond to them do not reverse the order of thought, as in cor-

rect synthesis, although the result of the actions should verify the accuracy of the analyser's speculative inferences.

It remains to consider in what mode art avails itself of these methods. With respect to æsthetics, it does not appear they have any but a faint application, on account of their *à priori* nature, and the consequent reverse method of procedure which obtains in the fine arts in contradistinction to the applied sciences. It often happens that principles are really involved in the works of an artist which the artist himself has probably never realised except in their abstract form. He exemplifies the laws of science not in consequence of any particular study of them, but in virtue of that taste and keen perception of beauty which imagination continually feeds within him, and which is only casually influenced in the highest genius by exterior observation and the study of the phenomenal world.

Perhaps in this field the most common use of analysis is in investigating the causes of defects. Something offends; we know not why. But in the endeavour to refer it back to first principles, we shall discover that some rule has been transgressed, some harmony violated, some canon of inconsistency broken. Thus very early attempts at art, through the want of consistency, often fail at the first touch of analysis. Notwithstanding the parts may be right in themselves, on no possible hypothesis could the whole be true. The same reason is fatal to the attempt of a Chinese artist to depict all the six sides of an interior at once; and to the conventional Egyptian representation of a man, in which the head, body, and lower members are depicted in three incompatible positions; and to the head of Minerva, on the archaic coins of Athens, in which the full eye, which figures appropriately in the front face, is transferred without modification to the profile.

In the earlier stages of the fine arts this seems to be the only use of analysis. In their most flourishing state there is nothing of that doubt and indecision which the analytical process implies. Great works are owing to the magic of genius, and not to any artificial study of particulars or formal process of thought. But when invention waxes cold, and the mind relies less readily on its own resources than the imitations of the past, then analysis steps in. It gives

rules according to which the highest processes of genius has spontaneously produced certain effects; and these rules will fall under the leading idea of the art, so far as the nature of the case admits, according to the ordinary methods of science.

These remarks are strictly confined to æsthetics, including not only music, painting, and poetry, but other works of an analogous kind which appertain to the highest order of genius. The case is different with many mechanical arts, in which an opportunity is afforded for strict consequence in the formation of the rules which can be deduced from certain empirical principles by means of the laws of space and number. Of this nature are many practical exemplifications of the laws of hydraulics, and pneumatics, and projectiles. Here the synthetical arrangement is more than a form, and the method of art, by coinciding with its type, loses its individuality, and melts into that of applied science[1].

Chapter IV. § 3.

The Senses an ultimate Source of Evidence.

Notwithstanding spectres and apparitions are generally brought in proof of the reality of sensible impressions, they are sometimes adduced on the contrary side; so that it is in some measure necessary to consider them here to complete the argument of the text.

If, as some contend, the senses can convey such delusive impressions as to lead persons who are usually accounted sane, to mistake the figures engendered by their own mind for realities, and converse with them as creatures of flesh and blood, why may not the senses generally be labouring under a similar delusion, and generating around us a world of shadows which have no existence out of the mind? Of the fact that the senses have thus grossly imposed upon the minds of many there can be no doubt. Respectable physicians, of whose veracity there can be no suspicion, have stated many striking instances of such deceptions; and the victims themselves have pined away, and in many cases died, of the

[1] Chretien, Logical Method, p. 205.

suffering produced by their shadowy tormentors, and the inability on their part to get rid of the impression that they were something more than mere shadows. Dr. Gregory tells us of a patient who daily, as the evening clock struck six, encountered a witch in form, something like those which are said to have greeted Macbeth on the heath of Fores, and who was so distressed by the grimaces of his weird visitor that he languished and finally died of a broken heart. Thus the Duke of Olivarez, in Le Sage, who was worried to death by the presence of an apparition, which he fancied always pursued him, was no imaginary character.

We find another case still more striking, vouched for on the most indisputable authority[1], in a lawyer who was first haunted by a cat, which subsequently took the shape of a gentleman usher, and appeared with cap, plume, and sword, like the ghost of Beau Nash, and then denuded itself of flesh and clothes altogether, taking the form of a skeleton. The last metamorphosis was fatal to the life of the sufferer. Sir David Brewster also narrates a series of remarkable apparitions to which a lady of his acquaintance was subject, sometimes assuming the garb of deceased friends, occasionally the shape of absent ones, and in every instance comporting themselves as to speech and behaviour like substantial creatures. She encountered her husband in the drawing-room, and held some moments' conversation with him at a time when he must have been two hundred miles distant, and she spoke to friends at her toilette who must have been rotting in their shrouds some five years before.

These apparitions would be certainly marvellous, and might throw grave doubt upon the testimony of the senses, if they did not admit of lucid explanation. But this, fortunately, is not wanting. We can not only theoretically account for the cause, but point out many instances of the cessation of the apparitions consequent on its removal. Spectral illusions, as Dr. Hibbert has shown, are nothing more than ideas, or the recollected images of the mind, which in certain states of bodily indisposition have been rendered more vivid than actual impressions; or, to use other words, that the pictures in the mind's are far more vivid than pictures in the body's eye. The mind's eye may be said to be the body's eye, and

1 Sir Walter Scott, Letters on Demonology and Witchcraft.

the retina the common tablet on which both classes of impressions are painted, and by means of which they receive their visual existence according to the same optical laws.

In the healthy state of the mind and the body, these two classes of impressions on the retina are nicely adjusted. The mental pictures are transient and feeble, and in ordinary states never capable of disturbing or effacing the direct images of objects. The two opposite impressions could not co-exist. The same nervous fibre which is carrying from the brain to the retina the figures of the memory, could not at the same moment be carrying back the impressions of external objects from the retina to the brain. The direction of the mind's attention to one of the two classes of impressions necessarily produces the extinction of the other. Hence, in darkness and solitude, when external objects no longer interfere with the pictures of the mind, they become more vivid and distinct, and in the state between waking and sleeping the intensity of the impression approaches to that of visible objects. With studious persons, who are much occupied with the operations of their own minds, the mental pictures are much more distinct than in ordinary persons, and in the midst of abstract thought external objects even cease to make any impression on the retina. A philosopher in his study experiences a temporary deprivation of his senses: noises and objects are conveyed to his eyes and ears, and his nerves actually receive the impressions of light, sound, and touch, but he fails to realise them. Now pictures of the mind and spectral illusions are equally impressions on the retina, only differing in vividness; and frightful apparitions are nothing more than the results of a disordered imagination acting on some accidental disarrangement of the vital functions.

The substantial correctness of this reasoning is evident from the state of those persons subject to such hallucinations, and the disappearance of the malady as soon as they returned to a healthy condition. Thus, the crowd of persons whom Nicholai[1] imagined he saw constantly moving and acting in his sight, gradually faded away as soon as he subjected himself to a course of medical treatment; and the ugly spectres with which the bright imagination of Tasso

[1] A bookseller of Berlin, who had the courage to lay his case before the philosophical society of that capital.

peopled his cell, and who sometimes contested with him his daily meal, grew imperceptibly less palpable as he recovered his health, and only annoyed him during inveterate periods of sickness. Again, the lady whose spectres were recounted by Sir David Brewster, convinced herself of their emptiness by standing in the positions and sitting in the same chairs the apparitions occupied, and finding nothing where they appeared to stand or sit but vacuity. All parity is consequently destroyed between such impressions and those which follow from the presence of tangible objects in the external world. Like the ordinary illusions of the visual organ, on pressing one eye or straining both, the apparitions are seen doubled; which of course could not be, had they, like sensible objects, any solid reality. They, therefore, must be classed with shadows; nor does their relation to that category throw the remotest doubt on the reality of the outward phenomenal world, with which, beyond the mere impression, they have nothing in common[1].

[1] For a further elucidation of the subject, see Eding. Journ. (new series) No. iv. p. 218—19, No. vi. p. 244, and No. viii. p. 261.

APPENDIX TO BOOK V.

Chapter I. § 2.

Classification and Nomenclature.

When we attempt to arrange natural objects in groups, according as they possess similar properties, and again to range these groups in regular gradation corresponding to the rank which each holds in the department of nature to which it belongs, the result is a system of classification. Considering the vast number of different objects embraced in each of the tripartite divisions of nature, and the necessity of having the evidence of all brought to bear on scientific inquiry at that stage of the proceeding in which their testimony is likely to be of any value, the importance of such classifications, and the care with which they should be framed, so as to bring not only all the properties of the objects they embrace into notice, but also the causes on which these properties depend, cannot be too much overrated. According, indeed, as these classifications are loosely or accurately framed will the respective sciences to which they correspond lag tardily behind, or exhibit signs of progress. When the facts of a case are lucidly and completely stated, a clever judge is not long in coming to a just decision. When any branch of natural phenomena is arranged in that form which is best calculated to bring out in bold relief all the striking properties it embraces, and the elements upon which those properties mainly depend for their origin and development, a sagacious observer seldom fails to get into the secret recesses of the phenomena and to pounce upon the law.

Such classifications have failed hitherto principally from their framers selecting arbitrarily some subordinate or non-essential point of agreement as the basis of their system, and thus throwing into the same group objects which in the general aggregate of their properties present no resemblance, and into different and remote groups others which have the closest similarity. Thus, the Linnæan arrangement of plants according to the number of stamens and pistils, or Tournefort's system, founded on the shape and the division of the

corolla, are positively mischievous; since they direct the attention to those properties in plants which are of the least interest, and thus hinder the mind from regarding them in the groups which have the greatest number of the most striking properties in common. Artificial arrangements of this kind hardly deserve the name of scientific classifications. They are more properly divisions in which the taste of the framer, or the particular end he may have in view, rather than the footprints of nature, serve as the guiding principle of the arrangement.

The classifications by which science is advanced are widely different from these. Instead of agreeing in nothing but arbitrary heads, from which the most important natural relations are rejected, these relations themselves are sought out and adopted as the basis of the system, and every object ranged in accordance with them, so as to represent the various kinds which exist in nature as much as possible in the precise order in which they occur, and bring into view the most distinctive properties they exhibit. Classifications in natural history, for example, which have any claim to be natural, are founded upon those distinctions of kind which run throughout nature, and which place impassable limits between the different groups to which they refer; and not upon any arbitrary choice of the naturalist. These kinds are, of course, determined by the properties which are so fundamentally distinct as to interpose an insuperable barrier between the classes into which they enter; and such characters are selected to be a mark or type of the kind which point to the greatest number of subordinate properties in common with each group. Distinctions of kind, however, are not numerous enough to supply the whole basis of a classification. Very few, for instance, of the genera of plants, or even of the families, can be pronounced with certainty to be kinds. The great distinctions of Vascular and Cellular, Dicotyledonous or Exogenous, and Monocotyledonous or Endogenous, are perhaps differences of kind, since the lines of demarcation which divide these classes seem to go through the whole nature of the plants. But the different species of a genus, or genera of a family, usually have in common only a limited number of characters. A Rosa does not seem to differ from a Rubus, or the Umbelliferæ from the Ranun-

culaceæ, in much else than the characters botanically assigned to those genera or families. Notwithstanding such distinctions are marked out by properties limited in number, they may be eminently natural, provided those properties are important, and the objects contained in each group resemble each other more than they resemble anything which is excluded from it. But then these lower groups are to be arranged into higher classes and made, when it is possible, to correspond to kinds, the latter serving as a kind of exemplars or types of the subordinate classes which are grouped around them.

Such arrangements as we have described have reference to distinct compartments of natural history. There are, however, other classifications of a similar tendency which enter into every science, and which are based upon any prominent resemblance or analogy, whether as regard objects or laws. As soon as such point of agreement is perceived between any phenomena, they constitute themselves into a group or class which may become enlarged to any extent by the accession of new phenomena bound together by the same point of resemblance. In this manner the materials of science become grouped in classes, such as chemistry furnishes examples of in its various groups of acids, alkalies, sulphurets, &c., or optics in those classes of phenomena ranged under the heads of periodic colours, double refraction, &c.; and that resemblances themselves become traced, which it is the business of induction to generalise and include in abstract propositions.

The preceding kinds of classification refer not to any specific end, but are simply framed with a view to put the mind in possession of the whole of the properties and relations of objects embracing any wide department of nature; that when, in the course of its inquiries, any startling facts occur, or any theory is formed, it may bring to the contemplation of either one or the other all the knowledge which can possibly bear upon the subject. But classification is not confined to this method of arrangement by groups, nor do its advantages flow in any one channel. There is another kind which still bears more directly on the successful issue of scientific inquiry, and that is when we select as the groundwork of the classification some particular phenomenon whose

laws are to be investigated, and range all the objects which bear any resemblance to it in regular gradation, according to the degree in which they seem to possess the property the law of which is sought. This has been termed classification by series[1]. Suppose, for example, the law of transparency was the subject of inquiry, the collection of the most striking instances[2] of this phenomenon would be the first step in the investigation, as most likely to lead, by the method of concomitant variations, to the discovery of the cause. Hence classification by series often brings together a number of objects which have nothing in common except the one peculiar property which is taken as the head of the classification; as in that of colourless transparency, the list would comprise objects differing most widely in their nature, such as water, air, diamond, spirits of wine, glass, &c.; while the arrangement by groups, as in the botanical families of Euphorbiaceæ, Umbelliferæ, &c., or in the chemical classes of alkalies, metals, &c., bring together those objects which have most properties in common, and appear to possess a natural relation.

But every class formed on a positive resemblance of characters draws with it the consideration of a negative class, in which the resemblance does not subsist at all, or the contrary takes place. Now it is important, as Herschel observes, to distinguish between cases in which there is a real opposition of quality, or a mere diminution of intensity, in some quality susceptible of degrees, till it becomes imperceptible. For example, between transparency and opacity, there would at first sight appear a direct opposition; but on nearer consideration, when we consider the gradations by which transparency diminishes in natural substances, we shall see reason to admit that the latter quality, instead of being the opposite of the former, is only its extreme lowest degree. On the other hand, the opposite electricities; the north and south magnetic polarities; the alkaline and acid qualities of che-

[1] Mr. Mill assigns the merit to Comte of being the first to treat systematically this branch of classification (vol. ii. p. 321); but the subject was developed by Hunter in his physiological arrangements long before Comte had published his work. [2] Enumerated by Bacon in the second book of the Nov. Org. under the head of prerogative instances.

mical agents, and many other cases, exemplify not merely a negation of quality as levity or opacity, but an active opposition. Both these modes of classification were distinguished by Bacon in his positive and negative instances, and have their peculiar importance in the inductive process, by affording an opportunity of tracing a relation between phenomena by way of contrast, and by the observation of a correspondence in the scale of intensity[1].

With regard to nomenclature, three things are particularly desirable; first, completeness, or a name for each definite object; secondly, precision, or the necessity of one name applying to that object and to nothing else; thirdly, expressiveness, or that the name either denote the peculiar properties of the object or the position which it occupies in the system. Now science possesses two splendid examples of systematic nomenclature which combine these requirements; that of plants and animals, constructed by Linnæus and his successors, and that of chemistry, which we owe to the illustrious group of French chemists who flourished towards the close of the eighteenth century. There is, however, an essential difference between the two systems, which assigns the palm of perfection in this department to the latter. In chemistry the compound substances possess one property (the chemical composition), which is of itself sufficient to distinguish the kind, being a sure mark of all the other properties of the compound. All, therefore, that was required to meet the third condition of a systematic nomenclature was to give a name to every compound expressive of its chemical composition. But in botany and zoology no one property is of such a prominent nature as to allow itself to be taken as indicative of the others; Linnæus therefore was obliged to

[1] The two modes of classification by groups and series may be combined in zoology on the supposition that the investigations concern the laws of animal life, since all the natural groups which zoology embraces may be arranged in that precise order which is most calculated to reveal the law in question. But in any other compartment such a combination is hopeless. As in botany, for instance, were the phenomena of vegetative life to be inquired into, there is no arrangement of the different classes of plants in a serial gradation which could throw the remotest light on the subject, since their leading groups present no cases of variations in the particular point assumed as the basis of investigation.

express the nearest natural affinities of the kind, in lieu of its distinctive properties, by incorporating into its name the name of the proximate natural group, of which it is one of the species. Thus the name of every species was made to consist of the name of the genus, or natural group next above it, with a word added to distinguish the peculiar species. On this principle is founded the admirable binary nomenclature of botany and zoology. Linnæus found about seventeen hundred generic names, with a moderate number of specific names, sufficient to designate with precision the ten thousand species of vegetables known in his time; and, notwithstanding the number of generic names has since greatly increased, the augmentation has not kept pace with the multiplication of known species[1].

Chapter I. §§ 3, 4.

Formal Analysis in Physics.

To exemplify the mode by which the inductive inferences may be thrown into a corresponding series of syllogisms, and thus laid open to formal analysis, we subjoin the following example from Mr. Thomson's Outlines of the Laws of Thought:

"In Sir Humphrey Davy's experiments upon the decomposition of water by galvanism, it was found that besides the two components of water, oxygen and hydrogen, an acid and an alkali were developed at the two opposite poles of the machine. As the theory of the analysis of water did not give reason to expect these products, they were a *residual phenomenon*, the cause of which was still to be found. Some chemists thought that electricity had the power of *producing* these substances of itself; and if their erroneous conjecture had been adopted, succeeding researches would have gone upon a false scent, considering galvanic electricity as a *producing* rather than a *decomposing* force. The happier insight of Davy conjectured that there might be some hidden cause of this portion of the effect; the glass vessel containing the water might suffer partial decomposition, or some foreign

[1] Whewell's Hist. Induct. Scien. i. 489, and Mill's System of Logic, ii. p. 316.

matter might be mingled with the water, and the acid and alkali be disengaged from it, so that the water would have no share in their production. Assuming this, he proceeded to try whether the total removal of the cause would destroy the effect, or at least the diminution of it cause a corresponding change in the amount of effect produced. By the substitution of gold vessels for the glass without any change in the effect, he at once determined that the glass was not the cause. Employing distilled water, he found a marked diminution of the quantity of acid and alkali evolved; still there was enough to show that the cause, whatever it was, was still in operation. Impurity of the water then was not the sole, but a concurrent cause. He now conceived that the perspiration from the hands, touching the instruments, might affect the case, as it would contain common salt, and an acid and an alkali would result from its decomposition under the agency of electricity. By carefully avoiding such contact, he reduced the quantity of the products still further, until no more than slight traces of them were perceptible. What remained of the effect might be traceable to impurities of the atmosphere, decomposed by contact with the electrical apparatus. An experiment determined this; the machine was placed under an exhausted receiver, and when thus secured from atmospheric influence, it no longer evolved the acid and the alkali.

"A formal analysis of these beautiful experiments will illustrate the method of applying the rules of pure logic in other cases.

"I. Statement of the case, the *residual* cause being still undiscovered.
'The decomposition of water by electricity, produces oxygen and hydrogen, with an acid and an alkali.'

II. Separation of the *residual* from the principal cause.
a. 'The decomposition of water produces oxygen and hydrogen.'
b. 'The production of an acid and alkali in the decomposition of water *may be caused* by action on the glass vessel containing the water.' (Problematical Judgment—A.)

III. The latter Judgment disproved by a syllogism in Mood E A O, Fig. iii. with a conclusion that *contradicts* it.
'A case in which I employ a vessel of gold cannot involve any decomposing action on a glass vessel,
'A case in which I employ a gold vessel still gives the acid and the alkali,
'Therefore cases of the production of the acid and alkali are not always cases in which glass is decomposed.'

IV. Another attempt to suggest the residual cause.
'The acid and alkali are produced by the decomposition and impurities in the water employed.'
Syllogism in A A I, Fig. iii. *tending to* prove this.
'An experiment with *distilled* water must admit *less* impurity,
'An experiment with distilled water gives *less* acid and alkali,
'Therefore sometimes with less impurity we have less acid and alkali.'

V. 'The contact of moist hands' may be an additional cause of the residual phenomenon.
Improved syllogism in A A I, Fig. iii. to include this concurrent cause.
'An experiment with distilled water, and apparatus kept from contact of hands will admit *still less* impurity;'
'An experiment, &c. results in the production of still less acid and alkali,
'Therefore sometimes with still less impurity we have still less acid and alkali.'

VI. Amended syllogism. A A A. Fig. iii.
'A case where we use these precautions *in vacuo* is a case of *no* impurity,'
'A case where we use, &c. *in vacuo* is a case of *no* acid and alkali,
'Therefore a case of no impurity is a case of no acid and alkali.'

VII. Immediate inference from last conclusion.
'Cases of no-impurity are cases of non-production of acid and alkali,'
'Therefore all cases of production of acid and alkali are cases of some impurity;'
which was to be proved.

"An example like this brings into a strong light many of the characteristics of inductive reasoning. Forms usually considered to be deductive are here freely employed. The later steps tend to confirm the earlier, on which, however, they themselves depend; so that a mutual confirmation is obtained from setting them together. When the chemist substituted gold vessels for the glass, and inferred from the continuance of the effect under this change that the glass could have nothing to do with its production, it was formally possible in the then state of knowledge that the glass might be the cause in the one experiment, and the decomposition of the gold in the other. But the later steps, which showed that the effect varied with the variations in a circumstance wholly distinct from the decomposition of glass or gold, reduced the possibility of maintaining such a view to the very lowest amount. Even the premisses of particular syllogisms

in the chain are sometimes tested and corrected by the conclusion, although formally the conclusion should entirely depend upon the premisses. The experimenter expected to find that the use of distilled water would exclude *all* impurity; and he intended that his premiss should assert as much; but when it turned out in the conclusion that the supposed products of the impurity were still present, he was reduced to the choice between abandoning that cause and recasting his premiss so as to admit that the cause was still present—'the use of distilled water gives *less* impurity.'"

Chapter I. § 5.

Mathematical Reasoning.

Sir W. Hamilton has written an essay to disparage mathematical reasoning as a mental discipline, and quoted a host of writers who support the same view. His arguments, however, do not seem to us to go farther than to condemn an exclusive devotion to this species of learning as injurious to the mental faculties, and in this view can prove nothing. Excess in every study warps the mind to a degree proportionate to the intellectual capability of the learner; nor do we see anything in the isolated pursuit of mathematics calculated to produce this derangement more conspicuously than an exclusive devotion to classics or to metaphysics, or any other department of learning. For our part, if we are to be bored with learned monoculists, we should prefer the company of D'Alembert to Porson, of Lagrange to Dr. Bentley, desirous that the discourse should turn rather on substances than words, on realities than shadows.

The most that can be said is that the exclusive study of mathematics seems to injure the more common and useful mode of inference—viz., that by induction. Mathematical truths being, so to speak, infallible, the moral feelings, if neglected by their study, become less sensitive to the various degrees of certainty attending probable inference. As when one sense is carried to great perfection, the others are usually less acute; so mathematical reasoning seems in some degree to injure the other modes of ratiocination. Thus Napier wrote nonsense on the historical evidence connected with revelation, though he invented logarithms;

Galileo published a most absurd criticism on the finest modern epic in the same month in which he expounded the correct laws of motion; and Newton played the deuce with chronology and the prophecies of Daniel, while he was unfolding the arcana of the heavens.

Division of the Sciences.

Having treated logic as the science of inference, it will not form an inappropriate conclusion to a work of this character, if we direct the reader's attention to the various subjects in which its methods and rules are employed. As in the categories we found several tables differing from each other by the broad lines of demarcation set up by the different metaphysical systems on which they were projected, so in the classification of the various departments of human knowledge we meet with a similar diversity of arrangement, with this difference that the ancient attempts have been long ago abandoned as imperfect, owing to the false views which their framers entertained of physical science[1].

The modern attempts at a general classification of the sciences may be said to commence with Bacon, whose projection, though surprising for his age, is based on a false principle. Considering all human knowledge as relative, Bacon was led to believe that the sciences would unfold themselves in natural order, if mapped out in relation to the three distinctive powers of the mind, Memory, Imagination, and Reason; as, however, these faculties are simultaneously engaged in the production of every mental work, the most complete confusion was the result of carrying Bacon's principle into detail. Formal science was confounded with real, experimental with deductive, relation of law and relations of theory with relations of facts—groups of sciences connected with the closest affinity divorced from each other, and the most heterogeneous subjects forced into the bonds

[1] Mr. Thomson discriminates a table of categories from a division of the sciences, by assigning to the former the function of pointing out the different attributes with which a conception may be clothed, and to the latter that of separating the different districts of knowledge with the leading and subordinate conceptions which belong to them from one another.

of association. The history of minerals, of vegetables, of animals, being confounded in this chart with the history of nations and the history of man, would place the labours of Boswell, in company with the labours of Cuvier and the researches of Hunter, by the side of the researches of Gibbon. Botany, zoology, and chemistry were separated from their histories and joined to metaphysics. Painting and music were ranked under the head of *artes voluptarias* with cookery and cosmetics. The anatomy of the human frame was severed from the anatomy of animals, and the doctrine of angels and spirits confounded with natural theology.

After Bacon, whose chart was adopted by Diderot and D'Alembert as the basis of their celebrated Encyclopædia, no similar attempt was made until Locke's time, who enlarged the Greek classification, as follows:

Physica	Experimental	Natural History. Physiology.
	Rational	Theology. Ontology.
Practica	Economics. Politics. Ethics.	
Σημειωτικὴ		Logic. Rhetoric. Grammar.

With the exception of Smith and Turgot, who followed Locke, the subject has not been philosophically considered by any writer of public importance down to very recent times. Dugald Stewart, in reviewing the past efforts to construct a genealogical chart of the sciences, pronounced the labour hopeless, at least in his generation.

Coleridge, however, imagined he saw in the relations of necessity and the relations of choice a clue to the entire labyrinth of human knowledge in the systematic order in which it is viewed by superior intelligences; and after a vague and sanguine development of his theory, in a style suited rather to the dim magnificence of poetry than to philosophic disquisition, he surveys the domain of knowledge from

The central point of the intellect,	Necessary relations	Formal—*i. e.* purely intellectual.
		Real: Moral sciences. Mixed sciences.
and thence proceeds to	Cause and effect, or Relations of theory.	Medicine. Chemistry. Fine Arts. Agriculture.

But as this division was far from exhausting the subject, Coleridge found himself obliged to institute a distinct head under "Miscellaneous," to which he consigned one-third of the Encyclopædia Metropolitana, whose groundwork was taken from his plan. To profess, however, to map out all the compartments of knowledge, and annex as a sequel to the chart a voluminous chapter of miscellanea, is precisely the case of Smalgruenius, who wrote a work entitled "*De Omnibus Rebus*," and afterwards added a supplementary treatise, "*De Quibusdam Aliis*."

But the chart is as theoretically wrong as it is practically worthless. Relations of necessity, and relations of cause and effect, instead of being co-ordinate branches of philosophy, are, considered abstractedly, no less intimately connected, than a general law with one of its particular exemplifications. We cannot, without subverting our mental constitution, consider matter otherwise than as subject to the great law which regulates the procession of phenomena, than we can believe that two and three make six, or that the whole is less than its part. Even in the objective light that Coleridge seems to have regarded the causal relation, far from being confined to any peculiar class of sciences, it runs through them all, and claims a co-extensive dominion with the empirical element itself. Instead, therefore, of being concentric with the transcendental relation, the laws of cause and effect, as here considered, are as subordinate to it as "Scientia activa," in Bacon's sense, is subordinate to the primary philosophy. Throughout the entire range of the sciences, with the single exceptions of logic and mathematics, necessary and causal relations are more or less interwoven with each other, and to regard them as separate branches leading to distinct groups of science, is to revive in a worse form the error of Bacon, which we have pointed out in the text.

Bentham in his Chrestomathia, adopting the bifurcate division which Ramus took from the Isagoge of Porphyry, attempted to draw a similar genealogical tree of the sciences, but found the first rough sketch so unpromising that he did not attempt to pursue the subject into detail. He fixed his point of departure, of course, in utility, which he divided into being in general, and what is not being; the first branch giving rise to metaphysics and the natural sciences, in so far

as they relate to the essences of things; the latter to the formal sciences, and those which embrace the accidents or changes to which all bodies spiritual or corporal are liable to undergo. It is needless to dwell upon a division which, if practically adopted, would confound all human knowledge, in obliterating the old landmarks which have, since science had a name, served to map out the boundaries of its diversified dominions, and in splitting up each subject heretofore considered unique and inseparable, into elements as various and multiform as the shifting light of opinion may choose to invest them with.

It was reserved for Ampère to distance all his competitors in constructing a chart of universal knowledge as theoretically perfect as it is practically useful, by adopting Dugald Stewart's fundamental division of matter and mind, and classifying everything he considered, in either of the two categories. The questions he asked himself concerning each science were, what subjects did it embrace, and in what point of view was it regarded by others? The first led him to fix its boundaries, and assign its correlations; the second to determine its place in the chart, and the groups of sciences by which it should be surrounded. In every other respect the order followed is precisely analogous to that adopted by Linnæus in the classification of the vegetable kingdom. Having divided his field into the two great kingdoms of matter and mind, Ampère groups the sciences whose boundaries he had previously laid down, in distinct families or kinds, which he collects into species of a higher order; and then proceeds to assign the leading branches or genera into which the cognate kingdom is divided, and in which the species of the scientific groups are included. The kingdom and branches with their subordinate orders and distinct families of sciences are connected with each other by a bifurcate division which separates the experimental sections—the *prodromi*, as Bacon calls them—from those which refer to the perfect sciences, and thus keeps distinct throughout, the deductive and empirical departments of knowledge. At the head of each rank stands its peculiar and leading idea. The subordinate orders being at once divergent and concentric, branching out into the numerous sciences of which they are composed, as well as guiding to the unique trunk whence

they spring. When we say that no groups of sciences are found together but those which reflect mutual light on each other, and whose proximity is therefore desirable in the study of the same art or profession; and that the knowledge of no science in the chart presupposes the acquisition of any which have not gone before, we have given the highest testimony in favour of its practical utility. We subjoin the tables *in extenso*, which Ampère spent the best part of his life in constructing. The Latin verses which follow point out the leading conception of each science in the chart, to which they bear literal reference, and enable the classical reader by a slight mnemonic effort to grasp the leading divisions of human knowledge in their most minute scientific speciality, and in that order most calculated to favour their study and development.

CLASSIFICATION OF HUMAN KNOWLEDGE; OR, SYNOPTICAL TABLES OF THE SCIENCES AND ARTS.

FIRST TABLE.—Division of Knowledge into Two Kingdoms, and of each Kingdom into Sub-Kingdoms and Branches.

FIRST KINGDOM.

Kingdom.	Sub-Kingdoms.	Branches.
Cosmological Sciences	A. Cosmologics, properly so called	I. Mathematics. II. Physics.
	B. Physiologics	III. Natural Sciences. IV. Medical Sciences.

SECOND KINGDOM.

Kingdom.	Sub-Kingdoms.	Branches.
Noological Sciences	C. Noologics, properly so called	V. Philosophics. VI. Dialegmatics.
	D. Social Sciences	VII. Ethnological Sciences. VIII. Political Sciences.

SECOND TABLE.—Division of each Branch into Sub-Branches and Sciences of the First Order.

FIRST KINGDOM.

	Branches.	Sub-Branches.	Sciences of the First Order.
A.	I. Mathematical Sciences	a. Mathematics, properly so called	1. Arithmology. 2. Geometry.
		b. Physico-mathematical Sciences	3. Mechanics. 4. Uranology.
	II. Physical Sciences	c. Physics, properly so called	5. General Physics. 6. Technology.
		d. Geological Sciences	7. Geology. 8. Oryctotechny.
B.	III. Natural Sciences	e. Phytological Sciences	1. Botany. 2. Agriculture.
		f. Zoologics, properly so called	3. Zoology. 4. Zootechny.
	IV. Medical Sciences	g. Physico-medical Sciences	5. Medical Physics. 6. Hygiène.
		h. Medical Sciences, properly so called.	7. Nosology. 8. Practice of Medicine.

SECOND TABLE—*continued.*

SECOND KINGDOM.

	Branches.	Sub-Branches.	Sciences of the First Order.
C.	V. Philosophical Sciences	*i.* Philosophics, properly so called ...	1. Psychology. 2. Metaphysics.
		k. Moral Sciences......	3. Ethics. 4. Thelesiology.
	VI. Dialegmatical Sciences....	*l.* Dialegmatics, properly so called ...	5. Glossology. 6. Literature.
		m. Eleutherotechnics..	7. Technesthetics. 8. Pedagogy.
D.	VII. Ethnological Sciences....	*n.* Ethnologics, properly so called ...	1. Ethnology. 2. Archeology.
		o. Historical Sciences.	3. History. 4. Hierology.
	VIII. Political Sciences	*p.* Ethnorytics	5. Nomology. 6. Military art.
		q. Ethnegetics	7. Social economy. 8. Politics.

THIRD TABLE.—DIVISION OF EACH SCIENCE OF THE FIRST ORDER INTO SCIENCES OF THE SECOND AND THIRD ORDERS.

FIRST KINGDOM.

	Sciences of the First Order.	Sciences of the Second Order.	Sciences of the Third Order.
A.	1. Arithmology ..	*a.* Elementary Arithmology	11. Arithmography. 12. Mathematical Analysis.
		b. Megethology	13. Theory of functions. 14. Theory of probabilities.
	2. Geometry	*c.* Elementary Geometry	21. Synthetical Geometry. 22. Analytical Geometry.
		d. Theory of Forms ...	23. Theory of lines and surfaces. 24. Molecular Geometry.

(*continued*)

THIRD TABLE—*continued.*

	Sciences of the First Order.	Sciences of the Second Order.	Sciences of the Third Order.
A.	3. Mechanics......	*e.* Elementary Mechanics	31. Cinematics.
			32. Statics.
		f. Transcendental Mechanics	33. Dynamics.
			34. Molecular Mechanics.
	4. Uranology	*g.* Elementary Uranology	41. Uranography.
			42. Heliostatics.
		h. Uranognosy	43. Astronomy.
			44. Celestial Mechanics.
	5. General Physics...........	*i.* Elementary general Physics	51. Experimental Physics.
			52. Chemistry.
		k. Mathematical Physics.	53. Stereonomy.
			54. Atomology.
	6. Technology ...	*l.* Elementary Technology...............	61. Technography.
			62. Industrial Cerdoristics.
		m. Comparative Technology...............	63. Industrial Economy.
			64. Industrial Physics.
	7. Geology.........	*n.* Elementary Geology..................	71. Physical Geography.
			72. Mineralogy.
		o. Comparative Geology..................	73. Geonomy.
			74. Theory of the Earth.
	8. Oryctotechny	*p.* Elementary Oryctotechny............	81. Mining.
			82. Docimacy.
		q. Comparative Oryctotechny	83. Oryxionomy.
			84. Mineral Physics.
B.	1. Botany	*a.* Elementary Botany	11. Phytography.
			12. Vegetable Anatomy.
		b. Phytognosy	13. Phytonomy.
			14. Vegetable Physiology.
	2. Agriculture ...	*c.* Elementary Agriculture	21. Geoponics.
			22. Agricultural Cerdoristics.
		d. Comparative Agriculture...............	23. Agronomy.
			24. Agricultural Physiology.

(*continued*)

THIRD TABLE—*continued.*

Sciences of the First Order.	Sciences of the Second Order.	Sciences of the Third Order.
B. 3. Zoology	*e.* Elementary Zoology	31. Zoography.
		32. Animal Anatomy.
	f. Zoognosy	33. Zoonomy.
		34. Animal Physiology.
4. Zootechny	*g.* Elementary Zootechny	41. Zoochresy.
		42. Zooristics.
	h. Comparative Zootechny	43. Œcionomy.
		44. Threpsiology.
5. Medical Physics	*i.* Medical Physics, properly so called	51. Pharmaceutics.
		52. Traumatology.
	k. Biotology	53. Dietetics.
		54. Phrenygietics.
6. Hygiène	*l.* Crasiology	61. Crasiography.
		62. Crasioristics.
	m. Hygiène, properly so called	63. Hygionomy.
		64. Prophylactics.
7. Nosology	*n.* Nosology, properly so called	71. Nosography.
		72. Pathological Anatomy.
	o. Iatrology	73. General Therapeutics.
		74. Medical Physiology.
8. Practical Medicine	*p.* Semiology	81. Semiography.
		82. Diagnostics.
	q. Medical Practice, properly so called	83. Special Therapeutics.
		84. Prognosy.

SECOND KINGDOM.

Sciences of the First Order.	Sciences of the Second Order.	Sciences of the Third Order.
C. 1. Psychology	*a.* Elementary Psychology	11. Psychography.
		12. Logic.
	b. Psychognosy	13. Methodology.
		14. Ideogeny.

(continued)

THIRD TABLE—*continued.*

	Sciences of the First Order.	Sciences of the Second Order.	Sciences of the Third Order.
C.	2. Metaphysics...	*c.* Ontothetics	21. Elementary Ontology.
			22. Natural Theology.
		d. Ontognosy...........	23. Comparative Theology.
			24. Theodicy.
	3. Ethics	*e.* Elementary Ethics	31. Ethography.
			32. Physiognomy.
		f. Ethognosy............	33. Practical Morals.
			34. Ethogeny.
	4. Thelesiology...	*g.* Elementary Thelesiography	41. Thelesiography.
			42. Diceology.
		h. Thelesiognosy	43. Apodictical Morals.
			44. Anthropotelics.
	5. Glossology	*i.* Lexiology	51. Lexiography.
			52. Lexiognosy.
		k. Glossognosy	53. Glossonomy.
			54. Philosophy of Languages.
	6. Literature......	*l.* Bibliology	61. Bibliography.
			62. Bibliognosy.
		m. Comparative Literature	63. Literary Criticism.
			64. Philosophy of Literature.
	7. Technesthetics	*n.* Terpnology	71. Terpnography.
			72. Terpnognosy.
		o. Comparative Technesthetics	73. Technesthetical Criticism.
			74. Philosophy of the Fine Arts.
	8. Pedagogics	*p.* Pedagogics, properly so called	81. Pediography.
			82. Idioristics.
		q. Pediognosy	83. Mathesiology.
			84. Theory of Education.
D.	1. Ethnology	*a.* Elementary Ethnology..................	11. Ethnography.
			12. Toporistics.
		b. Comparative Ethnology...............	13. Comparative Geography.
			14. Ethnogeny.

(*continued*)

THIRD TABLE—*continued.*

	Sciences of the First Order.	Sciences of the Second Order.	Sciences of the Third Order.
D.	2. Archeology ...	*c.* Mnemiology	21. Mnemiography.
			22. Mnemiognosy.
		d. Comparative Archeology	23. Archeological Criticism.
			24. Archeogeny.
	3. History.........	*e.* Elementary History	31. Diegematics.
			32. Chronology.
		f. Comparative History	33. Historical Criticism.
			34. Philosophy of History.
	4. Hierology......	*g.* Sebasmatics	41. Hierography.
			42. Symbolics.
		h. Comparative Hierology	43. Controversy.
			44. Hierogeny.
	5. Nomology......	*i.* Nomology, properly so called	51. Nomography.
			52. Jurisprudence.
		k. Legislation	53. Comparative Legislation.
			54. Theory of Law.
	6. Military Art...	*l.* Hoplismatics.........	61. Hoplography.
			62. Tactics.
		m. Military Art, properly so called	63. Strategy.
			64. Nicology.
	7. Social Economy.........	*n.* Chrematology	71. Statistics.
			72. Chrematogeny.
		o. Social Economy, properly so called	73. Dianemetics.
			74. Coenolbology.
	8. Politics.........	*p.* Syncimenics	81. Ethnodicy.
			82. Diplomacy.
		q. Politics, properly so called	83. Cybernetics.
			84. Theory of Power.

BENEVOLO LECTORI.

CARMEN MNEMONICUM.

PROŒMIUM.

Ut Mundum* noscas, moles[A] et vita[B] notandæ:
A. Mensura et motus primum[i], mox corpora[ii] et omne,
B. Viventûm genus[iii] et vitam quæ cura tuetur[iv].

Ad Mentem** referas quæ menti[C] aut gentibus[D] insunt:
C. Nunc animum[v], nunc signa animi prodentia sensus[vi],
D. Nunc populos[vii] disces et quâ ratione regendi[viii].

PROLEGOMENA.

A.

I. Hæc ubi cuncta animo raptim peragrare libebit,
Jam numeros[1], spatium[2], vires[3] et sidera[4] noris;
II. Corpora[5], fabrorumque artes[6] tractabis, et orbem[7]
Lustrabis; latebras penitùs rimabere terræ[8].

B.

III. Herbarum inquires genus[1], agricolæque labores[2];
Jam quæ sint[3], jam quos hominum fingantur in usus[4],
IV. Et quibus ægrescant vigeantve[5] animalia disces;
Nunc firmanda salus[6], nunc tempus noscere morbos[7],
Nunc ægris lethum durosque arcere dolores[8].

C.

V. Tum mentem[1], res atque Deum[2] meditabere et inter
Affectus hominum[3] virtus ut libera regnet[4];
VI. Tum voces[5] et scripta[6] simul, tum noveris artes
Ingenuas[7], et quæ pueri sit cura magistro[8].

D.

VII. Mox populos[1], monumenta[2] et facta[3] notabis;
Quos gentes servent ritus, quod numen adorent[4];
VIII. Jura fori, leges populorum[5] et munia disce
Bellantûm[6], mox gentium opes[7] scrutare, ducesque
Ut paci valeant et bello imponere morem[8].

SYNOPSIS.

A.

1. Si scrutari aveas quidquid cognoscere fas est,
Compones primùm numeros[11], ignota requires[12];
Nunc incrementa[13] et casus[14], nunc discere formas
2. Est opus[21], et formis numerorum imponere signa[22];
Noscere quæ gradiens generet curvamina punctum[23];
Primave concrescant queis rerum elementa figuris[24];
3. Et motus[31], et cûm pulsum in contraria vires
Corpus agunt, ubi stare queat[32], quorsùmve moveri[33];
Quo pacto hæreseant, trepident quo corpora prima[34];
4. Sidereasque vices[41], tellus quos erret in orbes[42];
Quæque regant vastos leges per inania motus[43];
Impulsûs quæ causa latens, atque insita rerum
Seminibus quæ vis undè astra per ætheris alti
Volvuntur spatia et cursus inflectere discunt[44].
5. Prœtereà scire in terris ut cuncta genantur,
Ut moveant sensum, formas vertantur in omnes[51];
Queis nexis inter se elementis corpora constent[52];
Necnon materiæ leges[53] viresque atomorum[54]
6. Noscendæ, et variæ quas usus protulit artes[61].
Tum quæstus[62] operumque modos conferre memento,
Ut potiora legas[63] causasque evolvere tentes[64].
7. Tum juga, tum campos disces et flumina[71], tellus
Corporibus[72] stratisque[73] quibus conficta sit intùs;
Hæc ut longa dies imis formaverit undis,
Utque efferbuerint olìm ignivomi undique montes[74];
8. Eruat ut cæcis occlusa metalla latebris
Fossor, et ardenti tractet mollita vapore[81];
Nec dubias telluris opes rimare prìusquàm
Impensas, lucrum[82], leges[83], causasque laborum
Et terræ ut subeas tutus penetralia noris[84].

B.

1. Jam quæ plantarum species ubicumque vigescant
Scire juvat[11]; jam quas celent sub tegmine partes[12];
Utque pares paribus rectè socientur[13], ut arbor
Herbaque nascantur, crescant et semina fundat[14];
2. Agricola ut lætas fruges ferre imperet arvis[21],
Quæ sint cuique solo foenus[22] culturaque[23], et undè
Langueat illa seges, gravidis hæc nutet aristis[24];
3. Quas soboli tradant generatìm animalia formas[31],
Corporis et quæ sit compages intima[32], vitæ
Quæ leges[33], gliscatque artus ut vita per omnes[34].
4. Nec tibi turpe puta, jucunda per otia ruris,
Bombyces nutrire, et oves vitulosque tueri;
Tum captare feras, tum lino fallere pisces[41];
Noscere quis pecudum sumptus[42], quæ cura bubulco[43];
Cur nunc utiliùs viridantia gramina carpant,
Nunc pecora in stabulis meliùs saturentur opimis[44].
5. Vitam multa juvant animantûm, multaque laedunt;

Sæpè graves possunt expellere toxica morbos[51];
Nostraque nunc lædit, nunc sanat corpora ferrum[52];
Illa nocent alimenta, hæc prudens sumere malis[53],
Sedulus insanos animi componere motus[54].
6. Non tamen ars medica est ulli tentanda prìusquàm
Noscat ut infundant nobis natura genusque
Jam varios habitus[61], quorum scrutabere signa[62];
Ut quod cuique nocens, quod cuique sit utile noris[63];
Tunc morbo disces venienti occurrere[64], et omnis
7. Naturam[71] sedemque[72] mali, medicamina[73], causas[74],
8. Queisque notis detur morbos dignoscere[81], et ægri
Scire quis[82] et quâ sit languor sanabilis arte[83],
Quis metus immineat, quæ spes sit mixta timori[84].

C.

1. Mentem nosse velis[11]: ut possit cernere verum[12];
Utque nova inveniat, vel ponat in ordine nota[13]
Quæras, et quo pacto ab origine cogitet[14] ac se
2. Noscere non tantùm valeat, sed resque[21] Deumque[22].
Tum subeunt scrutanda tibi commenta sophorum[23];
Humanâ ratione Deo quæ dantur inesse[24];
3. Affectus hominum, studia, oblectamina, curæ[31];
Quæ tibi corda notæ, quæ morum arcana recludunt[32];
Quod decet et quæ sunt metuenda optandaque[33], et undè
Indolis omne genus[34]; quæ mentibus insita nostris
4. Libera vis animi[41], justo secernit iniquum[42];
Quæ recti æternæ leges[43]; quæ præmia sontes
Insontesque manent[44]: stimulos hæc mentibus addunt
Ut nova discendi semper rapiamur amore.
5. Jam verborum usus[51], et verbis quæ sit origo[52];
Divèrsos ut apud populos mutentur[53], et undè
Concessa humani generi tam mira facultas
Quidquid inest animo ut voces expromere possint[54],
6. Assiduâ evolves curâ. Nunc alma pöesis,
Nec minùs arridens interdum sermo pedestris,
Pectora mulcebunt[61], scripta explorare libebit[62];
Et quæ digna legi indignis secernere[63], et arte
Noscere quâ sacrum nomen mereare pöetæ[64];
7. Ædes, suave melos, picturæ et dædala signa[71];
Necnon undè placent[72], artis præcepta modusque[73],
Principium et ratio[74] pergunt dulcedine mentem
Pellicere ad studium longosque levare labores,
8. Nunc puerum edoceat sapientis cura magistri[81],
Discipuli ingeuium tentet[82], fingatque vicissìm
Ad studium veri[83] præscriptaque munia vitæ[84].

D.

1. Indè loca[11], indè situs datur explorare locorum[12],
Prisca licet conferre novis[13], et verba habitusque
Corporis, ut valeas populorum exordia nosse[14].
2. Jam veterum monimenta virûm[21], jam scire memento

Quæ retegant[22]; ut vera queas dignoscere fictis[23],
Quâ fuerint exstructa manu, quâ condita causâ[24].

3. Factaque perquires[31], factorum tempora[32], veris
Undè fides[33], quæ causa olim concusserit orbem,
Cùm tot bella forent, tot regna eversa jacerent,
Ambirentque novæ rerum fastigia gentes[34].

4. Jam nosces ritus et dogmata relligionum[41],
Symbola quæ celant mysteria sacra profanos[42],
Et quo sit cultu veneranda æterna potestas[43],
Quoque modo oblitos ævi præcepta prioris
Diffusus latè populos invaserit error[44].

5. Quæ sint, quæ fuerint leges et publica jura[51],
Quæ solerti egeant præsertim interprete noris[52];
Quæque nova instituenda, ævo cùm prisca fatiscunt,
Nunc exempla docent[53], et nunc enitere recti
Legibus æternis humanas promere leges[54].

6. Disce et queis armis arcendi finibus hostes[61];
Quo pacto instaurandæ acies[62], quo bella gerenda[63],
Fregerit et virtus ingentes sæpè catervas[64].

7. Mox et opes[71], mox undè fluant[72], populisque parentur
Nunc facilis victus[73], nunc lætæ munera vitæ,
Et sortem ut mutare queat gens inscia rerum,
Cùm segnes torpent mentes meliora perosæ[74].

8. Foedera quid jubeant[81], quâ sint servanda sagaci
Arte[82], et securâ cives ut pace fruantur[83];
Quæ fluxa et quæ sit mansura potentia regum[84].

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THE END.

C. WHITING, BEAUFORT HOUSE, STRAND.